NATUR CYMRU
Nature of Wales

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Freshwater issue

- *Extreme weather*
- *Y Tywyddiadur*
- *Monitoring at sea*
- *Nature at historic sites*
- *Pine martens*
- *Ecology comes of age*

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Llun y clawr/Front cover:
'Standing in it' by Gerald Dewsbury. Trapped in Tre'r Ddol by floodwater, Gerald took the chance to sketch the effects of the floods on wildlife. His work can be seen at Ffin y Parc, Betws y Coed; the Royal Cambrian Academy, Conwy; the Kooywood Gallery, Cardiff; and the Twenty Twenty Gallery, Much Wenlock.

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GOLYGYDDOL EDITORIAL

Mae drycinoedd y gaeaf diwethaf yn awgrymu'r newid hinsawdd y bydd angen inni ymaddasu iddo. Mae dwy erthygl yn edrych ar effeithiau'r tywydd, fel y'u hadlewyrchwyd mewn dyddiaduron ac y'u profwyd yng nghymunedau gwledig. Edrych un arall at ymdrechion i achub cregyn dilyw (cregyn gleision perlog dŵr croyw), sy'n dibynnu ar ddyfrffosydd iach, naturiol, ac yn helpu eu glanhau ar gyfer eogiaid: ac un arall ar effaith cynlluniau trydan dŵr ar adeiledd a gweithrediad ecosystemau afonol, a sut mae cysoni'r angen am ynni adnewyddadwy ag afonydd iach wrth ystyried cynlluniau newydd.

Mel Parry Photography

Llanberis lake and Snowdon
Llyn Peris a'r Wyddfa

Rhoddwn sylw i esblygiad proffesiwn eang ecoleg, ac edrychwn eto ar hanes y chwilio am y bele'r coed swil. Cawn gipolwg, hefyd, ar y byd o dan y tonnau, canlyniadau deng mlynedd ar hugain o arolygu bywydegol manwl yng Ngwarchodfa Natur Forol Sgomer. Mae gan ecoleg ac archeoleg cymaint yn gyffredin: mae yna gydadwaith cyfoethog rhwng datgelu hanes preswyliad dynol ar y tir hwn, a natur. Mae'n dda iawn gennyf gynnwys erthygl sy'n ymhyfrydu yng nghyfoeth naturiol safleoedd hanesyddol gwerthfawr.

I gloi, dwi wedi rhoi gofod i deyrnged i Morgan Parry. Bu gan Morgan gysylltiad agos â'r cylchgrawn hwn, yn sylfaenydd, yn gyfrannwr, ac yn gefnogwr. Yr oedd hefyd yn hyrwyddo agwedd gwell, mwy cydgysylltiedig at yr amgylchedd. Ac yr oedd yn benderfynol na foddid achos natur Cymru a dyfodol cynaliadwy yng nghyfrifoldebau rheoleiddiol Asiantaeth yr Amgylchedd, gynt. Mae'r her yn eglur, fel y mae'r gwobrwyon. Dwi'n meddwl y dylwn roi'r gair olaf iddo ef.

Gan ysgrifennu yn *British Wildlife* (Rhagfyr 2011), gan ymateb i'r cyhuddiad nad oedd yn gweld angen mawr am Warchodfeydd Natur Cenedlaethol, dyma fo'n cywiro'r gwall. "Yn fy marn i, gan eu bod nhw [*GNC*] yn gydrannau hanfodol gweithrediad ecolegol mewn planed sydd wedi'i gor-ecsbloetio, bydd wastad eu hangen." Yna datblygodd y dadleuon dros gorff amgylcheddol unigol yng Nghymru, ond ychwanegodd: "Mae creu corff newydd yn strategaeth fentrus iawn, serch hynny: bydd rhaid inni sicrhau sylfaen gadarn ar wyddor naturiol (â digon o adnoddau) a thystiolaeth, a sicrhau na chollir bywyd gwyllt ymysg y swyddogaethau rheoleiddiol mawrion. Ond gall mentro llawer esgor ar ennill llawer."

The storms of last winter provide intimations of climatic change to which we will need to adjust. Two articles look at the impacts of weather as reflected in diaries and experienced in rural communities. Another looks at attempts to save freshwater pearl mussels, which depend on healthy, natural watercourses, and help to clean them up for salmon; while another examines the impact of hydro-electric schemes on the structure and function of river ecosystems, and how to resolve the need for renewable energy but also for healthy rivers when considering new schemes.

We cover the evolution of the wide-ranging profession of ecology, and revisit the story of the search for the elusive pine marten. We also get a glimpse of a world beneath the waves, the results of 30 years of detailed biological monitoring at Skomer Marine Nature Reserve. Ecology and archaeology share so much: there is a rich interplay between the unfolding story of human occupation of this land and nature. I am delighted to include an article celebrating the natural riches of precious historic sites.

Finally, I have devoted space to a tribute to Morgan Parry. Morgan had a close association with this magazine, as a founder, contributor and supporter. He also championed a better, joined-up statutory approach to the environment, and was determined that the cause of Welsh nature and a sustainable future would not be submerged in the former Environment Agency's regulatory responsibilities. The challenge is clear, as are the rewards. I think I should give him the final word.

Writing in *British Wildlif*e (December 2011), in reply to the accusation that he saw no great need for National Nature Reserves, he put the record straight. "My view is that, since they *(NNRs)* are core components of ecological function in an over-exploited planet, they are always going to be needed." He then developed the arguments for a single environmental body in Wales, but added: "Creating a new body is still a high risk strategy, though: we will have to ensure a well-resourced natural science and evidence base and make sure wildlife is not lost amongst the big regulatory functions. But taking risks can bring big rewards."

James Robertson

Natural History

Bridging the gap between the historic and natural environment

What does a dormouse have in common with an ancient fort? The answer is probably more than you'd think, as CADW's Director, ***MARILYN LEWIS****, explains.*

At first glance it can be difficult to draw comparisons between the historic and natural environments but look closer and the connections are there. Take a Cadw historic monument and dormice for example. Both have been around for thousands of years and both are protected by law.

Cadw, the Welsh Government's historic environment service, cares for 129 historic sites. These include castles, burial chambers, abbeys and pre-Roman fortifications, and some of these sites are ruins that were left to nature for hundreds of years. It's inevitable that over that length of time they will have received some new visitors and residents and it's therefore no surprise that many Cadw sites are now home to a wide variety of natural species.

Historic and natural environments go hand in hand in a country like Wales, yet tend to be treated separately. No part of the Welsh landscape is

truly natural, because people have lived and worked on every part of it. No heritage site is without its natural inhabitants and many of our historical assets are starting to be appreciated as important wildlife habitats too.

The custodians and conservation teams working at Cadw monuments are very aware of wildlife law and biodiversity issues. We are now also starting to work with wildlife experts to give us a better understanding of the wildlife at our sites and how we can manage them to improve their wildlife value without compromising monument conservation or visitor safety.

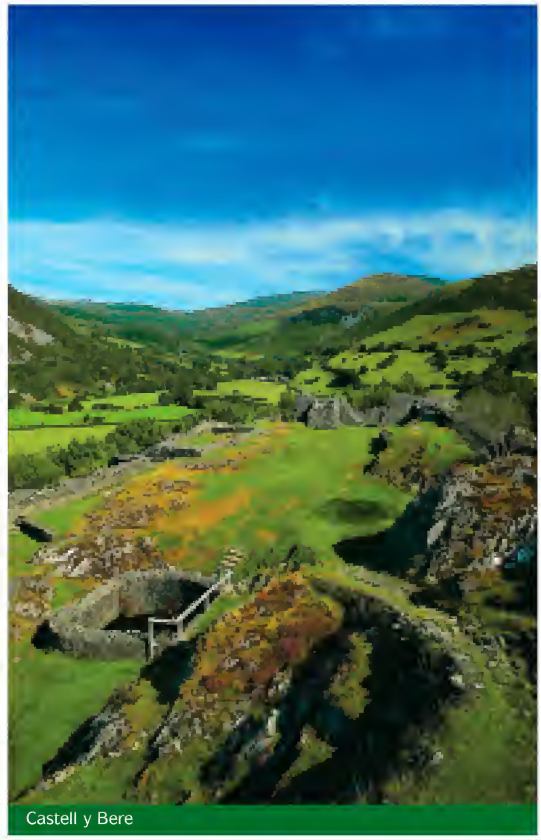
While wildlife considerations can mean that some activity on sites is regulated, we see our wild residents as an asset. Visitors are always surprised and delighted to discover wildlife at Cadw sites. Most people have a leap of excitement if they spot an owl or an otter on a visit to one of our monuments, although these encounters are rare. Our staff, opening and closing the sites at dawn and dusk, get the best sightings of their non-paying visitors.

There is a huge opportunity for us to capitalise on the interest of our human visitors in the natural as well as heritage merits of our sites.

Living proof

At Castell y Bere (right), you will see how closely linked the natural and historic environment are in Wales. The site is of great historical importance; it is the distinctive remains of a native Welsh castle, probably begun by Prince Llywelyn ab Iorwerth ('the Great') around 1221. It is also part of a stunningly beautiful landscape, surrounded and occupied by wildlife.

Another great example is Llanmelin Hillfort, near Caerwent. The Iron Age hillfort was originally constructed around 300BC and was a stronghold of the local tribe, the Silures. Cadw acquired it for one reason, which was to protect its heritage value – and in 2012 it was the subject of a community excavation project we led with assistance from Archaeology Wales. The team unearthed a wealth of clues about life at Llanmelin, with evidence of copper smelting and antler carving. Large quantities of animal bone revealed the presence of cattle, sheep, pigs and red deer. During our investigations most of the site was not disturbed, but visitors could not help but notice the wild flowers and the bird song.



Cadw

Castell y Bere

Cadw

The Iron Age hillfort at Llanmelin

Llanmelin is a stunning site, and when you visit you appreciate its essential character. Despite no on-site parking facilities and a steep hill to climb, it is worth the effort! It is surrounded by woodland which has been in situ for hundreds of years. Because of its location and access limitations the land hasn't been 'improved' and hasn't been grazed for many years, so there has been very little fertilisation of the soil. Because of all these factors the site is now probably just as interesting for its natural heritage as it is for its historical significance.

Hands-on experience

Personally, I have a very keen interest in nature. My husband, Dave, and I have been members of the RSPB throughout our married life and we've recently obtained our dormouse handling licences, thanks to training provided by Gwent Wildlife Trust (GWT) and in particular their volunteer co-ordinator Keith Allen, who knows everything there is to know about dormice.

I invited Keith and other GWT volunteers and specialists to Llanmelin, and as soon as he saw it he could see the wildlife value of the site, but he was also struck by the hillfort itself. Volunteers from GWT had spent years working very close to Llanmelin with no idea of its existence. They were amazed by the site and its natural assets, which clearly included badgers and many kinds of birds, and they are very hopeful that it also provides a home for bats, something which we will be testing in a survey evening later this year. Our archaeologists were thrilled to see how much they valued the site. The enthusiasm from both 'sides' is infectious and inspiring.

We had noticed that, in the past, dormouse boxes had been positioned around the site, although there was no record of any monitoring having taken place. In early 2013 Dave and I, with the support of Keith Allen, relocated 60 boxes around the whole site and, armed with our new licences, we registered the site with the National Dormouse Monitoring Scheme and spent the rest of the year visiting the site once a month, peering hopefully into each box.

During our visits we spotted plenty of animals in the boxes – nesting blue tits and great tits; the more common woodmice and yellow necked mice; even a nest of wild honey bees, but unfortunately as the year rolled on, still no sign of the elusive dormouse!

Cadw

Marilyn Lewis and her husband Dave hold the dormice discovered at Llanmelin Hillfort

Therefore during our routine visit to Llanmelin in October last year we were very surprised to open one of the boxes and find two little dormice snoozing together – it was like winning the lottery! We had the pleasurable task of weighing them and checking to see if they were male or female before posting them carefully back in their box. For the record, they were both males – an adult and a juvenile.

It's not easy work. The boxes need to be hidden away in the undergrowth, which often means walking through brambles over uneven ground, and the weather can make the going even more challenging. But we left Llanmelin with big grins on our faces that morning and have high hopes for 2014.

It was a great find and fantastic to know that our protected Cadw site is home to this protected species. It's also an added bonus for Cadw staff to know the site is of a great natural importance, as well as a historical gem. Our monuments are the perfect home for many species. Mammals, birds and reptiles wriggle into the cracks in the stone structures, and sleep in arrow slits in castles or undercrofts in abbeys.

And it's not just animals. Because our buildings have been standing for so long, and because they are protected and relatively undisturbed, you also find that they home to rare plants and lichens. Llanmelin, for example, has important rare plant species such as wild liquorice. In 2014 Gwent Wildlife Trust is running a wildflowers identification day for us at the site, and has already provided advice on how we can manage the site for the benefit of nature as well as history

Vicki: Creative Commons Attribution 2.0 Generic

Jackdaws have long used buildings for nesting

enthusiasts. Cadw would hope to work with other wildlife bodies on similar projects across Wales.

***Marilyn Lewis** has been Director at Cadw, the Welsh Government's historic environment service, since 2005. She has overall responsibility for leading Cadw, which sits within John Griffiths, Minister for Culture and Sport's portfolio within the Welsh Government. You can find out more about Cadw by visiting http://cadw.wales.gov.uk/ and about Gwent Wildlife Trust's 2014 events programme at http://gwentwildlife.org*

Mike Peel www.mikepeel.net

Rearing chicks in Conwy castle

Natur a hanes

Mae Cadw, gwasanaeth amgylcheddol hanesyddol Llywodraeth Cymru, yn gofalu am 129 safle hanesyddol. Pan fydd pobl yn gadael eu hen gartrefi mae'n anochel y bydd bywyd gwyllt yn symud i mewn. Gall gwaith cloddio ddatgelu llawer am fywyd gwyllt y gorffennol, ac mae staff Cadw yn ofalus tu hwnt ac yn gofalu nad ydynt yn tarfu ar breswylwyr newydd y safleoedd hyn. Gan eu bod yn cael eu gwarchod a chan nad oes dim wedi aflonyddu arnynt am gymaint o amser, gall hen adfeilion fod yn gynefinoedd perffaith i rywogaethau prin o blanhigion a chennau, a gall mamaliaid, adar ac ymlusgiaid guddio ymhlith y cerrig.

Hydro-electric schemes

Capturing energy from the flow of water and the force of gravity is potentially a benign, carbon-free technology, as the restoration of an early scheme at Plas Tan y Bwlch (see NC 48) illustrated. But upland hydropower schemes carry environmental risks to stream ecosystems. Here ***KYLE YOUNG*** *considers the mechanisms which are in place to balance benefits and costs, and the challenges which need to be met to ensure that this source of renewable energy is truly sustainable.*

An abstraction point located at the top of a bedrock cascade

Mountains and rain: Wales has plenty of both. As well as a beautiful landscape, this geoclimatic coupling provides Wales with countless kilometres of small, steep streams. These streams are important habitats for numerous plants and animals, including salmonids (salmon and trout) which attract hopeful anglers from around the world. They can provide something else: energy. Where mountains, rain and gravity meet, energy results. This energy erodes banks, transports gravel downstream, and deposits sediment on floodplains. It creates and destroys aquatic habitats as it slowly moves our mountains to the sea. It can also be harnessed to generate electricity through hydropower.

Green power, clean profit, murky water

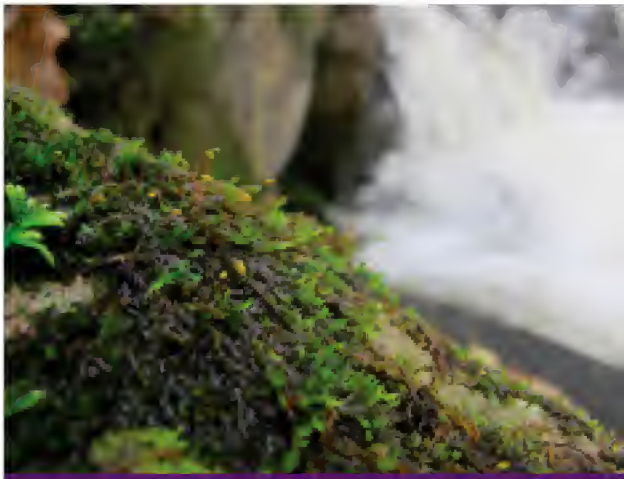
There are over a hundred hydropower schemes producing electricity in Wales. The vast majority are 'high-head' schemes: water is impounded by a weir, removed from the stream, and run downhill through a pipe to a turbine, where mechanical energy is transformed into electricity that is

used and/or fed back into the national grid. The abstracted water is then returned to stream at the bottom of the depleted reach. The benefits of hydropower are obvious. After balancing the financial and 'carbon' costs of planning, paying consultants and solicitors, constructing and transporting materials, and building and maintaining the scheme, hydropower produces carbon-free electricity, and profits for those who sell it. Of course, these activities also create jobs and stimulate wider economic activity.

There are, however, ecological risks. The structure and function (stream ecologist speak for 'health') of river ecosystems, and their resilience to climate change, depend in part on two factors: 'longitudinal connectivity' and 'natural flow regimes'. Longitudinal (upriver/downriver) connectivity allows the natural movement of sediment, organic matter, energy and fishes through stream channel networks. The natural flow regime (the timing and magnitude of flow variation) is the hydrological background around which species have evolved and biological communities are organised. High-head hydropower schemes disrupt longitudinal connectivity with impounding weirs and alter flow regimes within depleted reaches. A large body of scientific evidence suggests that by doing so, these schemes will impact the river ecosystems of Wales.

These impacts are well studied. For example, weirs that interfere with trout migration can change patterns of abundance and result in alternative resident and sea trout life histories: in the extreme they can lead to the local extinction of small populations which have become isolated above migration barriers. Natural flow variation can affect fish differently during the various stages of their life cycle, and altering natural flow regimes by abstraction can alter fish, invertebrate and plant communities. However, much of the evidence for such impacts comes from 'big' and 'extreme' cases, so it is difficult to predict how the smaller schemes popular in Wales will impact on stream ecosystems. Improved standards will undoubtedly help. Incorporating fish passes will reduce some of the impacts of fragmentation, and 'less than all of it' abstraction rates should provide some protection for depleted reaches.

Sam Bosanquet



The entire British population of the Section 42 moss *Sematophyllum demissum* is in north Wales, where it grows on sloping rocks irrigated by rainfall or splash from waterfalls

The economic benefits of hydropower, therefore, are balanced by concern over the unavoidable ecological impacts. It's a debate which proceeds mostly outside the public gaze. There are at least three reasons why hydropower fails to capture our attention. Hydropower is mostly invisible. There are no giant wind turbines to sully our favourite view, no tall stacks spewing smoke. We don't care about what we don't see. The small-scale hydropower schemes popular in Wales don't produce much power. Socially acceptable development will only ever contribute a small percentage to Wales' national energy budget. If we 'went big', flooded a few valleys and drowned a few villages, heads would certainly turn, but history suggests that option is a non-starter. The environmental impacts are unappreciated. Everybody understands, wants to avoid, and will shout about a destroyed view or poisoned air, but the ecological health of a remote stream is well down the typical citizen's list of worries.

The big picture

Natural Resources Wales (NRW) is responsible for regulating hydropower development in Wales. Doing so requires balancing the demands of two key (among other) policy drivers. The EU's ten-year growth strategy, 'Europe 2020', sets ambitious climate change/energy targets for member states to achieve by 2020: reduce greenhouse gas emissions to 20% lower than 1990 levels; produce 20% of

An impounding weir in a small stream at low flow. At low flows all of the water is directed down the fish easement (right) and none is flowing over the abstraction screen (left).

energy from renewables; increase energy efficiency by 20%. The UK needs to work towards these targets, and Welsh Government needs to do the same. The UK government encourages hydropower development via a feed-in-tariff, whereby hydro-generated electricity is purchased into the grid at higher than market value.

Welsh Government also needs to work to improve the ecological health of our rivers. The EU's Water Framework Directive (WFD) requires member states to restore all rivers and streams to good ecological status, which is defined as "an expression of the quality of the structure and functioning of aquatic ecosystems".

Two factors underscore the challenge of reconciling hydropower development with these policy drivers. First, in the context of Wales's contribution to meeting the UK's 2020 commitments, the current scale of hydropower development is insignificant. Some ballpark figures make this clear. A typical hydropower scheme in Wales produces about 16kWh of energy, enough power for a handful of frugal homes. By comparison, a home solar power system might produce 3kWh, a small pole-mounted wind turbine a bit less, and a typical on-shore wind turbine enough electricity for hundreds of homes. Hydropower in Wales is about providing economic benefits to individuals and communities, not about restructuring the national energy budget or tackling global climate change. Second, water abstraction and

A bespoke screen prevents fish from entering the abstraction point below the stone wall (right). The stream flows through a notch in the impounding weir.

human-made structures that disrupt longitudinal connectivity are leading causes for Europe's and Wales's rivers failing to achieve good ecological status under the WFD. Hydropower sits uncomfortably alongside ongoing (inter)national river restoration efforts to remove weirs and restore natural flow regimes.

Clearing the water

Supporting hydropower development whilst protecting and restoring river ecosystems is a daunting challenge. Fortunately, a framework for meeting this challenge is in place. Welsh Government has placed sustainable development at "its heart", and aspires to deliver it using the ecosystem approach. Sustainable development aims to safeguard "resilient and diverse ecosystems that deliver economic, environmental and social benefits". Formalised through the Convention on Biological Diversity, the ecosystem approach is "a strategy for

the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way." It can improve natural resource management decision making through the application of twelve guiding principles.

Whilst all twelve principles are to varying degrees relevant to hydropower development in Wales, two appear particularly informative in the economic and ecological context of Europe 2020 targets and the requirements of the WFD.

Principle 4, Economic Drivers: *Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:*

- *Reduce those market distortions that adversely affect biological diversity;*
- *Align incentives to promote biodiversity conservation and sustainable use;*
- *Internalize costs and benefits in the given ecosystem to the extent feasible.*

Principle 5, Ecosystem Resilience: *Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.*

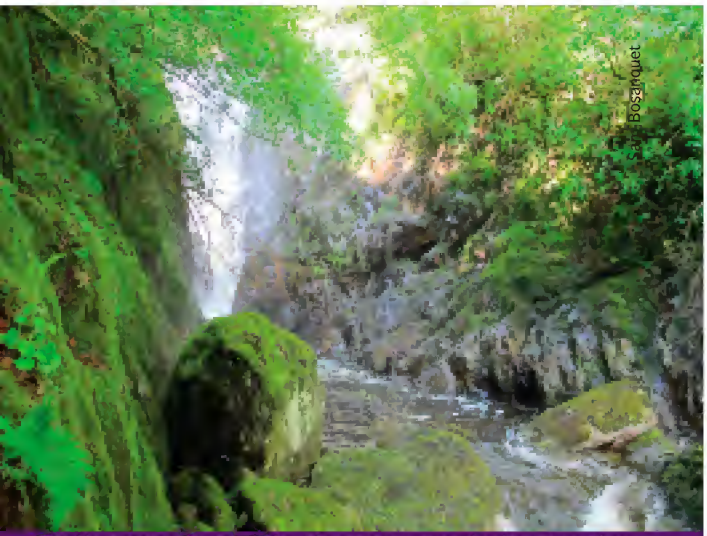
Each hydro-power scheme has to be customised to its surroundings

Bright future, glaring challenges

Following years of discussion and a formal public consultation (as part of the Environment Agency), in September 2013 the NRW Board adopted a new approach to managing hydropower development in Wales. Soon afterwards, NRW formed a Hydropower Working Group (HWG) where developers, community groups, and angling and environmental organisations worked together to finalise the guidance, which was published in January 2014. The guidance comprises over a dozen elements and aims to streamline the permitting process, support hydropower development, and protect river ecosystem structure and function. The process is admirable and the output reasonable. The HWG is a model approach with a bright future: the citizens of Wales should be proud.

Along with meeting a range of statutory obligations, NRW takes a two-tiered spatial approach to managing hydropower development. At the Wales scale, greater protection is given to designated sites and protected species. Hydropower development is discouraged, the burden of demonstrating no impact is on the applicant, and lower abstraction rates are permitted in Special Areas of Conservation or where flow-sensitive protected species are present. At the catchment scale, higher allowable abstraction rates are used to encourage hydropower development in steep/small headwater streams, where there are more opportunities, and the ecological impacts of fragmentation and flow modification will be more spatially limited.

The simplest challenge faced by NRW and the HWG is to ensure the new guidance is delivered efficiently, effectively and consistently across Wales. At least three more important challenges remain. The first is to actually apply principles of the ecosystem approach to hydropower development.



The Hyperoceanic liverwort *Harpalejeunea* grows on the downstream face of this boulder by the Afon Porth Llwyd, where humidity from a waterfall is held in a deep ravine

How can market distortions that adversely affect river ecosystems be accounted for in permitting decisions? How can the profits of individuals/groups be used to internalise the costs of degrading river ecosystems? How do we ensure the range of ecosystem services provided by our shared rivers benefit all Welsh citizens in an equitable way? How can we compare the benefits and ecological impacts of hydro, solar, and wind options to ensure renewable energy development is smart and sustainable? Without a genuine commitment by all parties to base Wales' renewable energy strategy on such questions, the promise of the ecosystem approach is unlikely to be realised.

The second challenge involves decommissioning. Society, as represented by lobbyists and government, supports hydropower development because it has decided that the economic benefits outweigh the ecological impacts. If a scheme becomes inoperable, there will no longer be any benefits to balance the impacts of the impounding weir and/or on-going abstraction. Currently, NRW's new guidance does not include a requirement for scheme owners to remove infrastructure once a scheme stops producing electricity. By including decommissioning conditions for all schemes licensed in Wales, the HWG can demonstrate its commitment to sustainable development and spare society the future cost of removing ecologically damaging infrastructure from our rivers.

The third challenge is monitoring. Hydropower schemes provide obvious economic benefits to consultants, developers, and private and community scheme owners. A large body of scientific research makes it equally obvious that disrupting longitudinal connectivity and altering natural flow regimes will impact stream ecosystems and their biological communities. The benefits and impacts of hydropower development in Wales need to be quantified. How much money is made? Who is making it? How is it being spent? What are the impacts on the biological indicators used for WFD status assessment? At what spatial and temporal scales do these impacts manifest? Do other renewable energy technologies provide a better balance between benefits and impacts? Currently, these critical questions are debated using words and belief. We need to do so using numbers and reason. A multidisciplinary monitoring programme will inform the essential process of adaptive management and ensure that renewable energy in Wales enjoys an informed, prosperous and sustainable future.

Kyle A Young *is a Lecturer at Aberystwyth University's Institute of Biological, Environmental and Rural Sciences. His research on fish and streams spans intersections of behavioural, evolutionary, community and applied ecology.*

Ynni Dŵr

Mae digonedd o ddŵr yng Nghymru, ac mae technoleg ar gael i drawsnewid hwn yn ynni trydan. Ar ôl ystyried costau carbon gosod y peiriannau, mae'n ymddangos mai dyma'r ffordd berffaith, gynaliadwy a di-lygredd o gynhyrchu ynni. Fodd bynnag mae gan y dull hwn ei anfanteision. Gall dargyfeirio llif naturiol dŵr effeithio ar lefelau afonydd a bioamrywiaeth. Mae canllawiau Llywodraeth Cymru yn defnyddio'r dull ecosystemol wrth sicrhau cyflenwad ynni glân ac iechyd ecolegol parhaus afonydd Cymru.

Sarah Davies

Weather extremes in Wales - *a historical perspective*

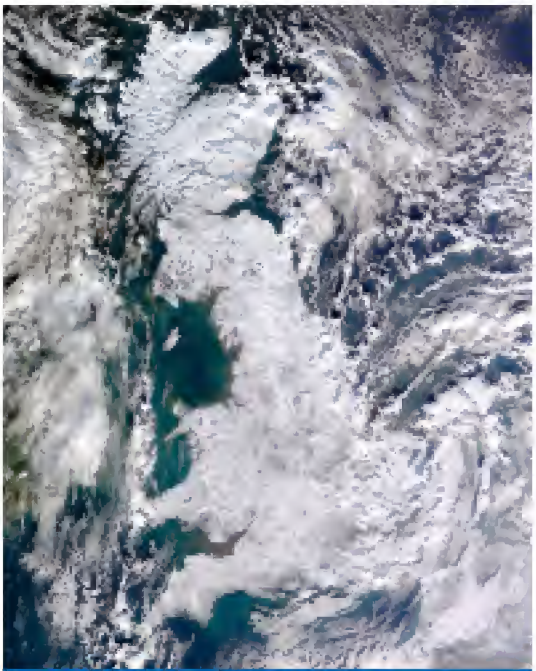
The storms that battered the Welsh coastline in early January have brought the debate about climate change and our vulnerability to weather extremes closer to home. ***SARAH DAVIES*** *and* ***CERYS JONES*** *from Aberystwyth University explain how documentary sources can provide a valuable long term perspective on the nature of weather extremes and their impacts on communities in Wales.*

Storm-damaged promenade at Aberystwyth

Here in the UK the weather is a constant source of discussion and debate, affecting our everyday decisions and providing an outlet for our anxieties and concerns. It is a safe, neutral topic about which to strike up a conversation with a stranger – everyone has an opinion. The stereotype of our national obsession with the weather is related, at least in part, to the considerable variability that we experience.

It is useful to distinguish climate - a summary of conditions, typically over a 30 year period - from weather, which is observed over a daily or weekly basis. The UK has a cool, temperate maritime climate, relatively mild for the latitude due to the influence of the Gulf Stream. Continental air masses have a greater influence in the east, whilst Wales and other western regions are wetter, dominated by circulation from the North Atlantic. Variations in our weather are caused by the strength and location of the jet stream and the interplay between these different air masses jostling for position above us.

NASA



The extent of the snow in Britain in 2010

The topography of Wales adds to the complexity, with our predecessor at Aberystwyth, G. Melvyn Howe, noting that "In Wales, the significance of 'climate' is decreased and 'weather' assumes an importance such as it enjoys in no other climatic type." With agriculture and tourism so important to the economy of rural Wales, many people's lives are closely tied to the changeable nature of our weather.

Recent extremes

The UK has experienced some particularly unusual conditions over the last few years. Drought across England and Wales from 2010 through to April 2012 gave rise to serious concerns about water resources and potential consequences for agriculture, wildlife and domestic supply (see www.ceh.ac.uk/data/nrfa/nhmp/other_reports.html). A sudden southerly shift in the jet stream brought heavy rainfall from Atlantic frontal systems across the UK. On the 8th June 2012, flash flooding hit the villages of Talybont, Dole and Llandre to the north of Aberystwyth, whilst in November extensive flooding affected Ruthin and St Asaph.

During the winters of 2009-10 and 2010-11, Arctic air masses brought freezing temperatures, significant snow fall and associated disruption. 2013 also saw severe conditions: the most profound impacts were felt in early Spring, with the UK experiencing the coldest March since 1962. Atlantic weather systems brought heavy rainfall and flooding to southwest England, turning to snow as they moved north and met colder air masses. Blizzard conditions and drifting snow in the uplands of North Wales, Northwest England and Scotland during late March led to desperate conditions for farmers during the lambing season, with significant livestock losses.

Most recently, the coast of Wales has taken a pounding from successive Atlantic depressions. This period of increased storm activity combined with high tides to create dramatic storm surges around the Welsh coast. Between the 3rd and 5th January 2014 widespread damage was caused to road and rail infrastructure, breaching sea defences, flooding properties and exposing archaeological evidence long-hidden from beneath the sands. The repair bill will run into millions of pounds and further storms are expected.

Looking to the past

The long meteorological records available in the UK provide an excellent framework for reconstructing climate over the last three centuries, but we also need information at a local scale which can capture individual, short-lived extremes further back in time. Archival sources not only contribute to the construction of detailed time, climate and weather histories but also provide a deeper narrative of an individual or community's experiences. We can examine the ways in which people responded to specific events and the types of coping strategies that were adopted. Such insights from the past can help to inform how communities in different contexts may respond to future change.

Information about the weather and its impacts can be found in personal diaries and correspondence; travelogues; newspaper reports; farm diaries and estate records: parish and council records; school log books: legal documents: and even in poetry and ballads. Elsewhere in this issue, Duncan Brown and Twm Elias discuss the nature of some of these

resources in more detail and explore the reasons why we have such a rich archive in Wales (page 28). Long, continuous records are particularly useful to us, such as those of the Venables family of Llysdinam Hall, Newbridge on Wye. Personal diaries and correspondence for 1808-1893, including those of Richard Lister Venables, curate of Clyro, are held at the National Library of Wales.

The diaries of William Bulkeley of Llanfechell, Anglesey, are held in the Bangor University archives and cover the period 1734-1743 and 1747-1760. Their importance as a resource for studying 18th century life and environment in North Wales has long been recognised. Llên Natur has almost completed a project to produce a full transcription alongside the digitised copies which are already available online. Bulkeley's diaries are important for climate research due to their relatively early dates and also because he did not travel often, so they provide a consistent account in a specific location.

Each daily entry starts with a brief but detailed description of the weather. Bulkeley's diaries also cover an interesting period in UK climate history. The 1730s were an unusually warm decade, brought to a rapid end with a series of cold years in the early 1740s. The winter of 1740 remains the coldest on record in the UK. Between 1734 and 1739, Bulkeley noted less than 20 days of frost per year. In 1740, he recorded 82! Descriptions of frost days, snow or rainfall all have the potential to be converted into numerical indices. This is an effective way of revealing change over time, but relies on the consistency with which the original information is recorded.

'I do not remember the weather so severe...'

Diaries also provide some of the most detailed commentaries on weather extremes. The diaries of Joseph Jenkins of Trecefel, near Tregaron, span the period from 1839 to 1868. Jenkins kept a daily record of the weather, along with notes on farm activities. His entries from spring 1867 describe a particularly testing period, with echoes of the difficulties faced by farmers in North Wales last spring. On Thursday 13th March, he writes, "I do not remember the weather so severe in March before. I went before dusk to see the young lambkins who were nearly starved and unable to suck their mothers..." Following heavy snowfall that night, his entry for 14th March states, "I did try to go and see the lambkins but alas they were almost all under the drifts. It was a great pity to see the ewes tearing the drift for them with their four legs..." Jenkins remarks several days later that even the oldest inhabitants cannot remember such severe and cold weather in

Floodwaters in Monmouth, 1929

Sarah Davies

Lambing suffers with late snowfalls

Henry Lamb

Flooding in Talybont, 2012

March. Substantial drifts had developed in the area, blocking lanes and roads, but heavy rain and a rapid thaw from 23rd caused flooding on the farmland as the River Teifi burst its banks (NLW Trecefel Family Diaries J/8: 1866/7).

Examining a range of sources over the same time period helps to establish the geographical extent of the weather event, and also provides independent verification regarding its nature and magnitude. On 14th March 1867 Richard Lister Venables, then curate of Clyro near Hay-on-Wye, in a letter to his brother in London, describes 10 inches of snow outside his window, declaring, "I never knew such a state of things in the middle of March." (NLW Llysdinam B, 1411). Newspapers report the widespread nature and severity of the snowstorms. Drifts 18-20 ft deep were reported in Eglwysilian, near Pontypridd (Cardiff and Merthyr Guardian 22nd March, 1867), and collieries were closed across South Wales. It was reported from Ebbw Vale that "so many hands were out of work that much distress and want must be felt in many families." (Monmouthshire Merlin, 23rd March 1867). The rapid thaw also led to tragedy, with the death of a widower father of eight in Nant-y-glo, washed away while attempting to clear a culvert. According to newspapers, the community rallied around to provide for the orphaned children, despite being in great need themselves on account of the lack of work.

"Calamitous Effects of the Late Thunderstorms in Cardiganshire"

Between 29th July and 1st August 1846, a period of intense stormy weather tracked across west Wales, causing devastating impacts across Ceredigion, particularly in the Aeron Valley. The local doctor, Dr Rogers, and his servant David Jones were swept away and killed by flash flooding. Numerous houses were washed away in Talsarn and Aberarth, whilst in Llansantffraed near Llanon, bodies were exhumed from the church graveyard by the force of the water. Approximately seventy bridges across the county were reported to have been lost. The financial losses to the community were regarded as 'irremediable', as those made homeless were 'principally of the poorer class' (The Cambrian, 7th August 1846). Agriculture was also hit hard, with significant loss of livestock and the corn and hay harvests affected by the heavy rains.

Financial aid for those affected by the flooding came from the wider community. A charitable fund was organised in Aberystwyth, the mayor himself going round door to door to encourage contributions (The Welshman, 11th September 1846). The community spirit demonstrated by residents of Ceredigion following recent floods clearly has its roots in the past. In a further similarity with recent extreme weather in west Wales, visitors from miles around were attracted to the area to "witness the melancholy of the infuriated elements" (The

Dave Thorpe

Ancient peat cuttings at Fairbourne uncovered by the recent storms

Welshman, 7th August, 1846). It has been suggested that we are becoming more fascinated with extreme events as our lives become increasingly disconnected from the natural environment and its inherent variability. Perhaps this is not the case – the unusual, the unpredictable and the dramatic have always captured our attention.

Lessons for the future?

None of the recent extremes observed in Wales are unprecedented. The historical record tells us that droughts, floods, snow and storms have all happened before and will undoubtedly occur in the future. The frequency of these extremes, their rapid switch from one to the other, is however more unusual. Is this related to climate change caused by human activity? In short, we can't tell – it is difficult to isolate the effects of human activity on a single extreme event with any degree of certainty. However, climate predictions indicate that we can expect to see more hydrological extremes and increased storm activity in the future. We are beginning to unlock the potential of the vast archival sources available to us for exploring past climate and weather in Wales. Learning from our past can help us to understand more about long term patterns and be more prepared for what lies ahead.

Can you help?

Do you have any information or memories about past weather extremes in your area? Perhaps you have old diaries or photographs that you would be willing to allow us to consult. We are part of a UK-wide project team working on historical weather extremes, led by the University of Nottingham and funded by the Arts and Humanities Research Council. We would be delighted to hear from you either by email or via the project blog at http://blogs.nottingham.ac.uk/weatherextremes/. Through the blog, we will be providing regular updates and highlighting notable stories from the archives. We will also be organising a number of events to publicise our work, so do keep an eye out for further information.

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Tywydd eithafol yng Nghymru – Golwg Hanesyddol

Mae'r tywydd difrifol a gafwyd yn ddiweddar yng Nghymru wedi codi'r drafodaeth ynghylch newid hinsawdd a pha mor agored i niwed ydym pan fydd tywydd eithafol yn digwydd yn agosach at adref. Mae cofnodion hanesyddol yn rhoi persbectif hirdymor gwerthfawr o ran natur eithafion tywydd a'u heffeithiau ar gymunedau yng Nghymru. Mae'r digwyddiadau y maent yn eu disgrifio, gan gynnwys llifogydd, achosion o bobl yn boddi, eira mawr a cholli da byw, yn swnio'n debyg iawn i brofiadau a gafwyd yn ddiweddar. Pan oedd pobl yn byw yn llawer agosach at fyd natur roedd colli cynhaeaf yn rhywbeth difrifol. Ond yn ddiweddar mae achosion o dywydd gwael i'w gweld yn digwydd yn fwyfwy cyson. Ni wyddom eto i ba raddau y bydd newid hinsawdd yn effeithio arnom yn y dyfodol.

Pearls in Peril

Freshwater pearl mussel *Margaratifera margaratifera* Cregyn gleision dŵr croyw

Freshwater pearl mussels are extraordinary creatures which fill an important ecological niche, improving conditions for other species by cleaning up water. They are also critically endangered. One project, based on the Afon Eden, is attempting to turn the situation around. ***ELAIN GWILYM*** *takes up the story.*

The freshwater pearl mussel (FWPM) *Margaritifera margaritifera* has been known in rivers of Wales since Roman times. They are believed to be one of the reasons why Julius Caesar and the Romans invaded Britain in 55BC. Historical records show that they were very abundant in our streams and rivers. The mussels were fished for pearls, and some from the Conwy River were collected and included in King Charles II's regalia.

The pearl mussel is declining throughout its holarctic range and has become one of the most critically endangered molluscs in the world. The species is protected under national and international legislation (UK Wildlife and Countryside Act 1981 Schedule 5, and EU Habitats and Species Directive Annexes II and V).

Incredibly, pearl mussels can live for more than 100 years, making them one of the longest-lived invertebrates, and they can grow as large as your hand. They live at the bottom of clean, dark, cool, fast-flowing, oligotrophic (nutrient poor) rivers, where they can be completely or partly buried in coarse sand or fine gravel. Amazingly, a single adult mussel can filter 50 litres of water a day; this is about the same amount

as you use when you have a shower. By filtering the water the pearl mussels remove particles for food and at the same time improve the habitat for other species such as salmonids (salmon and trout). Importantly, it is recognised that conservation work to conserve pearl mussels will ultimately benefit the river ecosystem as a whole.

The mussels require salmonid fish to complete their early lifecycle; the larval glochidia released by the adults must attach to the gills of a fish and overwinter there for about nine months before transforming and dropping off as juvenile mussels and burying themselves into the riverbed, where they continue to grow until mature enough to produce their own offspring. In a population review that was undertaken in 1983[1], it was suggested that a catastrophic decline of 81% had occurred in known British rivers. The primary reason for their decline is a lack of juvenile recruitment, causing a slow but steady decrease in numbers over many years.

A species under threat

The rapid decline of *Margaritifera* has been widely reported and this species is threatened with extinction across much of its range. Major threats include:

- Habitat loss, fine silts and soil entering the river smothering mussels and river gravels, unauthorised river engineering work, and changes in riparian land use.
- Nutrient enrichment, and industrial and agricultural pollutants such as nitrates and phosphates.
- Exploitation from (now illegal) pearl fishing.
- Reduction in salmonid populations.
- Water temperature – pearl mussels thrive in cool water and predicted rises of 1-2°C in Welsh rivers, as a result of climate change, could affect their ability to survive.

The Afon Eden in Meirionydd, Gwynedd is designated as a Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC). It is home to several important ecological features such as floating water-plantain, bog rosemary, water sedge, rare lichens, Atlantic salmon, large heath butterfly, otter, and the most important being the colony of freshwater pearl mussels. The Afon Eden is a

© JW/SNH

relatively unmodified river approximately 12km long. It is mainly upland in character, and it's very diverse. The upper reaches are comprised mainly of raised bogs, transition mires and quaking bogs. The land use is mainly low intensity agriculture.

Pearls in Peril (PIP) is a Life + Nature project with 22 partners working together to restore river habitats benefiting freshwater pearl mussel and salmonids in 21 SAC rivers across Britain. In Wales the work will be located within the Afon Eden catchment and led by Natural Resources Wales (NRW). PIP has a total budget of £3.5million, and aims to:

- RESTORE the habitat of freshwater pearl mussel and salmonids.
- SECURE the long-term survival of existing freshwater pearl mussel populations.
- COMMUNICATE with local, national and international audiences to raise awareness of freshwater pearl mussel conservation issues.

The Afon Eden's substantial FWPM colony was discovered in 1997[2], when it supported around 1300 mussels. By 2011 it was supporting around 550. These are just estimates, as many mussels can be completely buried in the river gravel and therefore cannot be counted, but this declining trend is seen across Europe. To combat this, PIP undertakes in situ works to create more viable habitats for recruitment.

©Pearlsinperil

features of interest on the Eden. Diffuse pollution is known to have a direct, significant, negative effect on the FWPM in the river, by reducing the water quality. The incidence of diffuse pollution in rivers is causing many of the tributary streams to fail to meet good ecological status under the Water Framework Directive. Some land management activities and drainage from the A470 trunk road contribute to the diffuse pollution issues affecting the Afon Eden. The trunk road adds a concentration of heavy metals, particulates and salt from road gritting in icy conditions. In partnership with the North and Mid Wales Trunk Road Authority (NMWTRA), PIP will be working with landowners, farmers and other stakeholders to create filtration systems that will reduce diffuse pollution flowing into the Eden.

Improving woodland and river habitat

NRW's Brynteg forestry block is part of the action to improve the riparian habitat (habitat that borders watercourses). The site is known to affect the natural hydrology of the catchment and is a source of acidification and run-off of nutrients and sediment into the river. It is also a key source of anthropogenic phosphate, which is released from the exposed peat soils after intensive tree felling operations. To address these issues, PIP is restoring the intensive conifer forestry to an area of native broadleaf, wet woodland and raised bog plant communities.

We will also be ditch blocking and creating settlement ponds on the tributaries of the Eden, thus trapping silt and improving the water quality. In some parts of the Afon Eden human intervention and management has changed the natural movement of river sediments. Historically, boulders and gravel were dredged from sections of the river leaving unsuitable habitat for pearl mussels. Part of the in situ work will include introducing local clean gravel as well as large boulders and woody debris. This will recreate diversity in flow patterns, so that areas of natural gravel deposition will develop. In turn these will provide suitable habitat for juvenile pearl mussels and spawning salmonids.

Good water quality is crucial in maintaining the

Monitoring and public awareness

An important part of the PIP LIFE project is to implement a structured programme of monitoring surveys. These will allow us to establish the existing conditions at the start of the project and indicate the successes of the project's actions. We will identify the abundance of host fish at specific sites and relate this to the presence of the adult pearl mussels on the river. Analysis of this relationship will make the data more useful for targeting the conservation actions.

Water quality monitoring is a key part of the project. Sonde data loggers will be used on many locations within the catchment and will provide invaluable data on the variation in water quality parameters along the river. The data will be very important in identifying sources of diffuse pollution and excess nutrients, which can then be followed up with targeted remediation measures. Salmonid encystment levels (the number of juvenile FWPM attached to the gills of salmon and trout) will also be monitored, and this data will help us understand the functioning of the FWPM colony. Combined, all of the monitoring data will contribute to the restoration of habitat and

©JW/SNH

inform conservation actions to secure the population's long-term future.

Fundamental to the aims of the project are engagement and participation with our stakeholders. We will undertake public awareness and dissemination events in all areas where major conservation actions are proposed. Raising awareness of the project and the pearl mussels is a very important aspect, as it is a means of ensuring that the project is a success and that many of the achievements will continue beyond the project lifespan. Podcasts, leaflets and interpretation materials will be created and will be available on the PIP website.

PIP delivers the 'Pearls in the Classroom' educational programme to local school children. This explores the pearl mussel's unusual lifecycle, its important cultural history, its decline, and its role within the river ecosystem. This programme aims to promote a good understanding of FWPM ecology as well as indirectly securing existing populations, as more families will be aware of the damage that can be caused to pearl mussel populations.

Freshwater pearl mussels have a long human history and an important place in the river ecosystem. The PIP project is excited about making a difference and securing the culture and ecology of this species into the future. This is only the beginning for FWPM!

Elain Gwilym *is Pearls In Peril LIFE+GB - Afon Eden Project Officer. See www.pearlsinperil.org or follow PIP on twitter @MoTheMussel.*

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Perlau mewn Perygl

Bu poblogaethau o gregyn gleision dŵr croyw'n hysbys yn afonydd Cymru ers oes y Rhufeiniaid. Credid bod eu perlau gwerthfawr wedi denu lwl Cesar i Brydain yn 55CC. Bu'r cregyn gleision â rhan bwysig yn niwylliant hanesyddol Prydain. Cynhwyswyd perlau Conwy yn nheyrndlysau Siarl yr Ail. Heddiw, mae'r gragen yn cael trafferth goroesi oherwydd (a) pobl yn eu lladd yn anghyfreithlon ar gyfer perlau; (b) mae arnynt angen dŵr glân, ond mae llawer o'n hafonydd yn cael eu llygru gan bobl a diwydiant; (c)mae pobl wedi difetha cynefin y cregyn gleision drwy sianelu afonydd.

Oherwydd y lleihad hwn, mae cynllun LIFE+ yr Undeb Ewropeaidd ynghyd â 22 partner arall ledled Prydain wedi llwyddo i sicrhau cyllideb o £3.5miliwn i geisio 'sicrhau dyfodol ar gyfer cregyn gleision dŵr croyw ym Mhrydain'. Enw'r prosiect yw "Perlau mewn Perygl", ac rydym yn gweithredu mewn 21 afon ledled Prydain. Dewiswyd ardal cadwraeth arbennig Eden yma yng Nghymru. Y bwriad yw:

- Adfer cynefin y misglod ac pysgod eogffurf brodorol
- Sicrhau goroesiad hir dymor i'r rhywogaeth
- Chyfathrebu gyda chynulleidfaoedd lleol, cenedlaethol a rhyngwladol i godi ymwybyddiaeth o faterion cadwriaethol misglod perl dŵr croyw.

Oherwydd y gall y cregyn gleision hidlo a phuro dŵr, mae ganddynt ran ddylanwadol yn yr ecosystem afonol. Mae'r prosiect yn gyffrous iawn oherwydd eu gallu dichonol i wneud gwahaniaeth. Gobeithia'r prosiect mai'r dechrau yn unig yw hyn!

Rohan Holt

Monitoring Wales' only Marine Nature Reserve...

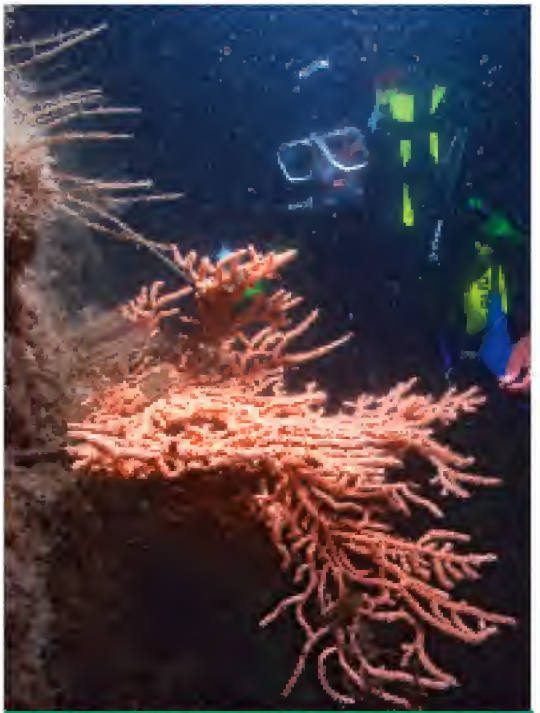
Meeting an old friend – pink seafan *Eunicella verrucosa*

It has become routine to monitor environmental change on land but, given the urgent need to manage marine resources sustainably, there is surprisingly little detailed biological monitoring of the health of our seas. Skomer Marine Nature Reserve provides a rare example. The monitoring, which benefits from the help of enthusiastic volunteer divers, has yielded a complex picture of winners and losers, as well as confirming the continued welfare of an old friend, as ***BLAISE BULLIMORE*** *describes.*

We sink down beside an algae-encrusted rope. Underwater visibility is about five metres – average good for the North Wall on Skomer Island's north coast. Fifteen metres down, the rope branches at a large knot. One branch disappears under a car-sized boulder, the other into a wide cleft in a rock ridge. So far, so familiar: it should be, I installed the first of these ropes in 1982.

I'm back now, 30 years later, with Phil Newman, the colleague who took over from me as manager of the Skomer Marine Nature Reserve (MNR), helping with the annual biological monitoring. We glide over the ridge, and a V-shaped cliff drops away vertically. I know it meets a steep boulder slope another 16 metres below me but it could be bottomless for all I can see into greenish black. Swim a little to the right, and a couple of metres below the lip of the cliff over there should be – ah yes, it's still there. It looks like a miniature, two-dimensional, peach-coloured, leafless tree. It's a pink seafan, *Eunicella verrucosa*, a warm-water-loving soft coral that is close to its northern limit of distribution. This one is an old friend.

The seeds of marine biological monitoring around Skomer were sown in the late 1970s, soon after the Skomer voluntary marine reserve was declared, with Robin Crump from the Field Studies Council as Scientific Secretary of its Management Committee. Surveys carried out by recreational divers during Underwater Conservation Year in 1977 – which led ultimately to the establishment of the Marine Conservation Society – paved the way for three of the projects that are a cornerstone of the current "citizen science" contribution to the MNR's monitoring programme. That same year, during a diving survey around the nearby island of Ramsey, Robin and I began a discussion about the need for regularly-repeated, long-term monitoring that eventually resulted in my setting up a permanent photo-monitoring transect on Skomer's North Wall.



Blaise Bullimore

1992: the seafan's size suggests it was over 100 years old. It is hardly any larger now

Monitoring change

Initial aspirations were modest: to document exactly what happens with some of the species whose growth rates and life-spans we know little about, and how communities change – or not – seasonally and over longer time scales. Additional sites were soon added to broaden the habitats and species covered, and particularly to include algae. Early findings confirmed that some species assumed to grow slowly did indeed do so, though rather more slowly than perhaps expected. I failed to find any sign of growth in my seafan friend in the first two years of sampling. Since then we have learned that newly settled fans can grow relatively quickly – a centimetre or more per year – but as they get older growth rapidly slows to 3mm or less per year. Several of the fans in the MNR are more than a half metre high and wide, suggesting ages of a century or more.

There were also surprises. Some sponges grew rapidly, others showed no detectable growth. One died back annually to an overwintering stump. Others regressed when conditions got tough – such as unusually low winter sea temperatures or particularly high levels of suspended sediment in the water – and recovered later. The importance of such factors as temperature and water quality in influencing species condition quickly became obvious, and this knowledge played a major role in the way the MNR monitoring programme later developed.

Designation of the statutory Skomer MNR in 1991 brought with it resources to enable the expansion and improved targeting of monitoring. Focus shifted

from trying to establish what was 'normal', to attempting to determine the condition of habitats, species and communities. As part of this change, particular attention was paid to what were perceived to be vulnerable species and habitats, in part moving toward what has since become known as risk-based monitoring.

From the beginning it was clear that simply knowing the condition and detecting change, particularly adverse change, was not going to be enough on its own to inform management requirements. We needed to be able to explain changes and identify whether their cause was natural or anthropogenic. Consequently a complementary surveillance programme of both human activities in and near the MNR and of hydrographic and other influential processes was also begun; sea temperature, salinity, turbidity and weather parameters are now routinely recorded.

For over twenty years the MNR's annual monitoring programme has been a mix of in-house projects, contracts and, since 1997, a four-year cycle of citizen science projects which require modest taxonomic expertise but a lot of diver-power. Whilst detailed intertidal community and grey seal monitoring are essential parts of the annual programme, most of the effort is on subtidal species and communities, ranging from

Skomer MNR (NRW)

Routine diver-monitoring sampling is non-destructive whenever possible, using either photography, video or in-situ recording, to ensure it has minimal or no effect on the species and communities under observation

anemones to *Zostera* (eel-grass), *via* sea-slugs, soft-corals, sponges, starfish and sediment communities.

A few of the underwater projects rely on remote sampling of the seabed or water column, for example using grabs, plankton nets or electronic instruments, but most are carried out by diving. To ensure that diver-monitoring has minimal or no effect on the species and communities under observation, routine sampling is non-destructive whenever possible, using either photography, video or in situ recording.

Volunteer effort

Early each year a dedicated group of volunteer divers book early to join that year's labour-intensive re-survey of either the MNR's eel-grass bed, or sea-urchin and starfish, scallop or territorial fish populations, carried out over two weekends with MNR staff support and guidance. Phil marvels at their enthusiasm: "The spaces fill up as soon

Blaise Bullimore

Sea-slug *Polycera faeroensis*

Skomer MNR (NRW)

This detached 40cm x 30cm seafan (left), several decades old, was found lying beneath a seafan holdfast (right) in an area rarely dived but regularly fished with shellfish pots

as we announce the survey," he says. "It's unbelievable that so many people keep coming back to spend hours in shallow water, in poor visibility, counting blades of grass!"

The data collected has proved invaluable. It has enabled us to compile detailed maps of the MNR's eel-grass bed, the smallest and most wave-exposed of the three in Wales, which show how it has increased in size and the plant density has changed. The scallop surveys have revealed an encouraging population recovery since their collection by dredging or diving was prohibited in 1988: mean density has increased by more than 25 times, though recovery at some sites slowed after 2006, and recovery at one or two sites has been much less than others. Surveys of territorial fish have demonstrated consistently higher densities of territorial wrasse at Skomer Island sites (no angling) compared with Marloes Peninsula sites (shore angling).

Seafans were one of the first vulnerable species of conservation importance to be included in the monitoring programme. The number of sites and fans under observation increased gradually from the four fans first photographed at one site in 1982, to 10 sites and nearly 120 fans by 2005. Working around carefully mapped sites, each individual fan is photographed on both sides by the MNR team every year, and the presence of tiny, specialised and highly cryptic predators that mimic the colour and shape of the seafan's anemone-like polyps are recorded *in situ*. Overgrowth by epibiota (algae and encrusting animals), entanglement by dogfish eggs, drift algae or debris, and any damage or tissue necrosis is recorded afterwards from the photographs.

Over the last twenty years, 13 mature seafans have disappeared and 10 new juvenile fans have been discovered within the mapped survey plots. Although losses appear to be only slightly greater than gains, the story is more complicated. Small juvenile seafans are inconspicuous and it may be that some recorded as recruits were simply overlooked previously. Also, since 2002, the MNR team have reattached seven fans that had become dislodged, either fastening them to the pitons used to mark the survey sites or gluing them into small rock crevices with epoxy resin. Most of these have reestablished their holdfasts on the rock to some extent, but without intervention these would also have been losses from the population.

The proportion of fans showing necrosis and damage has declined since an apparent peak from 2003 to 2005, but it's the cause and seriousness of damage that is important. Because the fans are only visited once each year, causes of damage are not usually detectable. However, in 2012 a fan was photographed with a shellfish-pot rope hanging tight around its base causing damage and a second large individual was found at the bottom of a cliff, having been cleanly severed from its base.

Causes of change

There is so much background sampling noise that it can be very difficult to determine what is going on with many species. Sediment deposited in calm weather or luxuriant algal growth obscures small species; wave action removes or relocates sediments and unseasonal storms can strip rocks of their algal cover revealing both known but recently concealed, and previously overlooked, sessile animals. The highly contractile bodies and feeding tentacles of many sessile marine species can change their appearance and volume from one sampling event to the next, depending on time of day, temperature, light, recent water movement and other factors. For

Skomer MNR (NRW)

Ropes connecting shellfish pots are a direct threat to fragile erect species such as this seafan

such species as cup-corals, anemones and small sponges, a single year's snapshot is insufficient; many years observations are essential before any judgement can be made as to their condition.

It is fairly clear that despite the data noise and the protection afforded the MNR, not all species in the MNR appear to be thriving: besides the decline in seafan numbers, another soft uncommon coral, red sea-fingers *Alcyonium glomeratum*, has shown a decrease in abundance, and the size distribution of the fragile ross coral *Pentapora foliacea* colonies appear skewed toward smaller sizes. On the other hand, some are thriving: as well as the increasing scallop population, the sediment-dwelling communities of worms and other small animals in formerly scallop-dredged areas are doing very well, and have gradually developed into some of the most diverse in Wales since dredging was prohibited. Can it be a coincidence that these are the species that have the most effective management in place to protect them?

So what about that big sea fan on the North Wall? It's not as cute as seal pups, clown-faced puffins or charismatic dolphins. Alone, it has negligible economic value and doesn't provide much in the way of ecosystem services. But its continued presence and health are still important.

It's difficult not to feel a bond with wildlife we have known personally for decades. I hope this fan will still be here next year. It's vulnerable to so many threats. It could get kicked off by a passing diver, though this is unlikely since the Skomer's North Wall is only for experienced divers and, after all, the divers that visit come to see such things as the seafan and they exercise their diving skills to leave the seabed as they find it. Suspended sediments, pollutants, plastic debris and warming seas are all threats, but a direct hit from a lobster pot or a rope on a string of pots is possibly the greatest direct risk. In its position here, tucked into the V on the vertical cliff, perhaps it's safe. I hope so, and I also hope the MNR team will still have the resources to come back next year to check.

Skomer MNR's annual project status reports include details and data summaries of all the individual projects; they are available on line here: ***http://www.wwmc.org.uk/skomer-mnr-allies/science-monitoring/***

Blaise Bullimore *began sublittoral monitoring on Skomer in 1982, carried out the support work for the Skomer MNR consultation, and was its first manager. He is now an Honorary Warden and still helps with the annual monitoring work.*

Monitro bywyd morol

Dechreuodd monitro biolegol morol o amgylch Sgomer ddiwedd y 1970au ac erbyn hyn mae hon yn ardal allweddol lle gall 'gwyddonwyr-ddinasyddion' wneud cyfraniad. Drwy ddychwelyd i'r un mannau bob blwyddyn daw plymwyr mor gyfarwydd ag organebau unigol fel y dônt yn hen gyfeillion. Dengys cofnodion blynyddol fod gan rai gwyntyllau môr gyfradd twf araf iawn, sy'n golygu eu bod yn gallu byw yn hŷn na 100 oed. Er eu bod mewn ardal warchodedig mae rhai yn dangos arwyddion o niwed gan raffau pysgota. Dim ond drwy gofnodi'r newidiadau hyn y cawn syniad o'r materion sy'n effeithio ar fywyd morol sydd o'r golwg.

Twm Elias

Y Tywyddiadur

yn cofnodi tywydd a ffenoleg yng Nghymru (rhan 1)

Dyddiaduron William Jones, Moelfre, Aberdaron (1858 - 1896)
The diaries of William Jones

Cronfa gynhyrfus o ddata hanesyddol a chyfoes am dywydd a ffenoleg Cymru yw Y Tywyddiadur. Mae'n rhan o brosiect Llên Natur sy'n cofnodi ac yn dathlu perthynas pobl a'r amgylchedd naturiol. Yn yr erthygl hon, y gyntaf mewn cyfres o ddwy, mae ***DUNCAN BROWN*** *a* ***TWM ELIAS*** *yn disgrifio'r gwahanol fathau o ffynonellau gwybodaeth sydd ar gael ac yn sôn am y modd y mae gwaith ymchwil yn seiliedig ar y data sydd eisoes wedi ei gasglu yn dechrau dangos perthnasedd yr wybodaeth i astudiaethau ehangach ym maes yr amgylchedd a newid hinsawdd.*

Cronfa ddata ryngweithiol sy'n olrhain tywydd a ffenoleg Cymru dros y dair canrif ddiwethaf yw Y Tywyddiadur ac mae'n rhan o brosiect Llên Natur, Cymdeithas Edward Llwyd (www.llennatur.com). Fe lansiwyd Prosiect Llên Natur yn 2009 i geisio casglu ynghyd wybodaeth a sylwadau amrywiol am bob agwedd ar fyd natur a'r amgylchedd yn y Gymraeg. Cynhwysir cofnodion am rywogaethau, ffenoleg, y tywydd, lluniau, enwau rhywogaethau a chynefinoedd, llenyddiaeth, enwau lleoedd, llên gwerin a pherthynas pobl â'r byd naturiol o'u cwmpas yn gyffredinol. Gwerthfawrogwyd y prosiect eisoes fel enghraifft deilwng o Wyddoniaeth y Werin.

Mae'r ffynonellau'n amrywiol iawn, gan gynnwys defnyddiau hanesyddol sydd eisoes mewn print, e.e. cylchgronau, llyfrau, papurau newydd ac ati, a defnyddiau nas cyhoeddwyd erioed o'r blaen megis dyddiaduron, llawysgrifau, llythyrau, cardiau post yn ogystal â gwybodaeth lafar.

Creu'r Tywyddiadur

Ers lansio Llên Natur sylweddolwyd bod cyfoeth o wybodaeth hanesyddol

ar gael yn ymwneud â thywydd a ffenoleg Cymru a allai fod yn adnodd ymchwil pwysig. Yn 2012 daethpwyd â'r elfennau hyn o wybodaeth hyn at ei gilydd dan bennawd 'Y Tywyddiadur', gyda'r bwriad o greu gwefan chwiliadwy fyddai'n agored i unrhyw un sydd am ei defnyddio. Daeth yn amlwg hefyd y gall cyd-destun cymdeithasol a thraws-ddisgyblaethol y data gyfoethogi a chyfrannu at ein dealltwriaeth o sawl maes.

Erbyn hyn, gyda dros 86,000 o gofnodion dyddiedig a lleoliedig (Ionawr 2014), cydnabyddir bod Y Tywyddiadur, drwy wneud yn gyraeddadwy lawer o ddata na fu ar gael i ymchwilwyr hyd yn hyn, yn cynyddu ein gwybodaeth am batrymau tywydd a datblygiad yr hinsawdd dros y dair canrif ddiwethaf. Daw hyn â ffynonellau Cymraeg eu hiaith i mewn i brif lif gwybodaeth ac ymchwil hinsoddegol Cymreig ac Ewropeaidd.

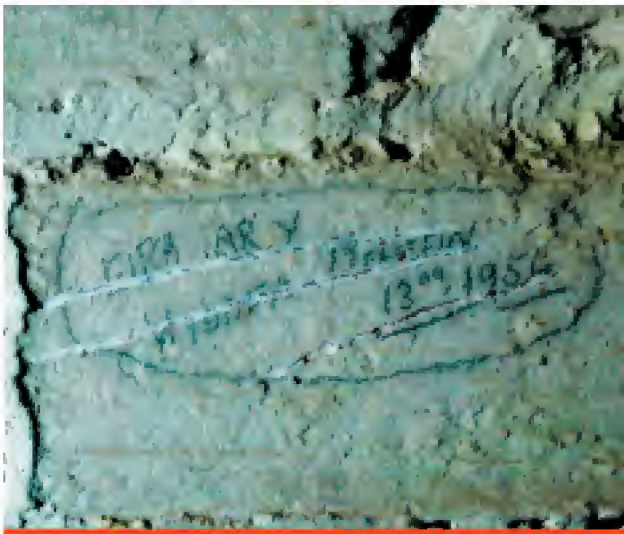
Testyn yr ysgrif bresennol (y gyntaf o ddwy) yw cyflwyno'r ffynonellau Cymraeg yn unig, ond pwysleisir mai cronfa ddata gynhwysfawr aml-ieithog yw Y Tywyddiadur, yn cyflwyno unrhyw gofnodion yn eu hiaith wreiddiol. Ar hyn o bryd mae 37% o'r cofnodion yn Gymraeg, 63% yn Saesneg, gyda ychydig yn Ffrangeg neu Lydaweg. Yn yr ail ran cyflwynir astudiaethau achos manylach.

Cyfrannu at ymchwil hinsoddegol

Gyda rhai eithriadau, prinhau a mynd yn fwy gwasgarog wna cofnodion meteorolegol mesuradwy cyn dechrau'r 20fed ganrif ac yn fwy fyth felly cyn 1854 pan sefydlwyd y gwasanaeth meteorolegol cenedlaethol cyntaf i ynysoedd Prydain. Golyga hynny, os ydym am ddeall a chreu modelau i ddisgrifio patrymau tywydd a datblygiad ein hinsawdd cyn hynny bod raid wrth ddata digonol y medrir ei gymhwyso i lenwi'r bwlch.

Gall y cylchoedd blynyddol mewn coed a rhai mathau o gregyn môr roi gwybodaeth fuddiol i ni am newidiadau o flwyddyn i flwyddyn dros gyfnod hir iawn, ond fel arfer ni all y math yma o ddata ddweud llawer am yr amrywiaethau o fewn y flwyddyn. Dyma lle gall data disgrifiadol, sy'n cofnodi patrymau dyddiol y tywydd a'r tymhorau fod yn ddefnyddiol. Data megis o ddyddiaduron a llyfrau log llongau ac

Steven Roddick



Graffiti, Chwarel Dinorwig, yn cofnodi eira ar yr Wyddfa, Mehefin 1954
Graffiti, Dinorwic quarry, recording snow on Snowdon, June 1954

ysgolion. Mae cofnodion am dywydd eithafol yr un mor bwysig a mae hanesion digwyddiadau o'r fath hefyd yn britho papurau newydd a chyfnodolion. Ac nid yw'n anghyffredin cael barddoniaeth i goffáu ambell ddigwyddiad – traddodiad sy'n mynd a ni nôl cyn belled â'r Canol Oesoedd mewn rhai achosion.

Y ffynonellau

Penderfynwyd bod unrhyw gofnod amgylcheddol oedd â dyddiad a lleoliad iddo yn deilwng o'i gynnwys, fel yr oedd, yn Y Tywyddiadur. Wrth reswm, yn absenoldeb dull safonol o gofnodi, rhaid ystyried y gallasai amgyffred personol y dyddiadurwyr, o bob dosbarth, ar wahanol gyfnodau ac mewn gwahanol ardaloedd fod wedi lliwio'r hyn a gofnodwyd. Rhaid gochel rhag camddehongli geiriau ac idiomau tafodieithol; camdrawsgrifo ambell air o'r ysgrif wreiddiol a bod yn ymwybodol o'r camddyddio all godi mewn rhai achosion wrth i galendrau Prydain ac Ewrop bendilio rhwng y drefn Jiwliaidd a Gregoraidd, sydd â gwahaniaethau nid yn unig rhwng dyddiau (mae hyd at 11 diwrnod o wahaniaeth rhyngddynt) ond rhwng blynyddoedd hefyd.

Gwaith y defnyddiwr yw dehongli'r dystiolaeth at ei ddibenion ei hun a gochel rhag y peryglon hyn. Er hynny, drwy gymharu cofnodion nifer o wahanol bobl o'r un digwyddiad ar yr un dyddiad gallwn farnu i ryw raddau 'gywirdeb' unrhyw gofnod unigol.

Liz Morris, Marine EcoSol

Mae cylchoedd twf *Arctica islandica* yn awgrymu patrymau tywydd blynyddol
The growth rings of *Arctica islandica* hold clues to annual weather patterns

Dyddiaduron Cymraeg – rydym yn lwcus yng Nghymru bod gennym draddodiad hir o gadw dyddiaduron. Er hynny, ychydig iawn o rai Cymraeg eu hiaith a gyhoeddwyd hyd yma, o leiaf rhai sydd â chynnwys amgylcheddol. Eithriadau yw, er enghraifft, dyddiaduron Defi Lango[1] a DO Jones, Padog[2].

Rhyfeddod y dyddiaduron hyn (mae oddeutu 15 o ddyddiaduron Cymraeg sylweddol eu maint wedi eu mewnbynnu i'r Tywyddiadur a nifer o rai llai), yn enwedig rhai'r 19eg ganrif, yw eu bodolaeth o gwbl o ystyried diffygion a Seisnigrwydd y drefn addysg ffurfiol drwy wledydd Prydain, a diffyg llythrennedd ymysg y werin.

Ceir argraff mai ffermwyr cyffredin, ond diwylliedig a dysgedig yn yr ysgrythurau neu bobl wedi eu gwreiddio'n ddwfn yn eu cymdeithas wledig oedd yn bennaf gyfrifol am gadw eu dyddiaduron yn y Gymraeg. Ymhlith dyddiaduron mwyaf nodedig Y Tywyddiadur mae'r rhai sy'n perthyn i'r canlynol; Edward Evans (Parsele, Llanedryn, Sir Benfro, 1851-1871); William Jones (Moelfre, Aberdaron, 1858-1896); Ioan Brothen, Llanfrothen, Penrhyndeudraeth (1886-1937); John Jones (Crowrach, Bwlchtocyn, Llŷn, 1922-1954) a DO Jones (Padog, Dyffryn Conwy, 1934-1955+).

Tueddiad pob carfan arall o'r gymdeithas (boed yn Gymry Cymraeg neu beidio) oedd cwympo i ysbryd Brydeinig eu hoes ac ysgrifennu yn y Saesneg, hyd yn oed dyddiadurwyr dysgedig Cymraeg megis Eben Fardd a'r naturiaethwr TG Walker, prifathro Ysgol Henblas, Llangristiolus, Môn (1941-1971). Ond ni ellir bod yn rhy bendant ynglŷn â hyn gan fod nifer fawr o ddyddiaduron eto i'w harchwilio yn archifdai Cymru heb son am rai sy'n hel llwch yn eu cartrefi gwreiddiol.

Tybed pam fod ffermwyr Cymru wedi mynd ati i gofnodi eu gweithgareddau tymhorol, tywydd y dydd, dyfodiad y gôg ac yn y blaen yn y Gymraeg? Mae'r ateb yn ein hanes:

- Diwygiad Anghydffurfiol Cymraeg ei iaith (18fed ganrif)
- Ysgolion teithiol Griffith Jones, Llanddowror yn golygu mai Cymru oedd un o wledydd mwyaf llythrennog Ewrop erbyn yr 1770au
- Ysgol Sul Thomas Charles o'r Bala o ddiwedd y 18fed ganrif yn rhoi i'r Cymry y gallu i ysgrifennu yn ogystal â darllen.

Esgorodd hyn ar boblogaeth werinol a feddai ar gryn barch at y diwylliant Cymraeg ac at addysg ffurfiol, hyd at ein dyddiau ni heddiw. Cawsai'r dyddiadurwr fudd mawr o'r ddisgyblaeth o ysgrifennu a chofnodi, yn ogystal â chael corff o wybodaeth bwysig wrth law am ei waith beunyddiol – o'r union adeg aeth yr hwch at y baedd i ddeall yn well amrywiaeth y tywydd a'r tymhorau yr oedd ei fywoliaeth mor ddibynnol arnynt.

Llythyrau a negeseuon ysgrifenedig – ffynhonnell arall bwysig i'r Tywyddiadur yw llythyrau. Efallai mai'r enwocaf o'r llythyrwyr Cymraeg eu hiaith yw Morrisiaid Môn[3] yn y 18fed ganrif. Yn wahanol i batrwm y ganrif ganlynol mae llythyrau toreithiog y Morrisiaid yn ddwyieithog yn yr ystyr eu bod yn newid o'r Gymraeg i'r Saesneg fel petai ar fympwy.

Mae negeseuon ar gefnau cardiau post yn ffynhonell bwysig arall. Mae'r cerdyn post fel genre yn rhychwantu'r 20fed ganrif, i bob pwrpas. Daethant i fodolaeth ar ddiwedd Oes Fictoria a rhagwelir eu tranc yn gynnar yn yr 21ain ganrif gyda thwf y ffôn

symudol a chyfryngau cymdeithasol eraill. Un o brif bwrpasau anghydnabyddedig cardiau post yw cofnodi'r tywydd, ond prin a gwasgaredig yw'r rhai Cymraeg ymysg y myrdd o rai Saesneg.

Papurau newyddion a chyhoeddiadau eraill – gall papurau newyddion gynnig gwybodaeth wreiddiol a chyfoes am ddigwyddiadau tywydd, yn enwedig yr eithafol neu'r anarferol. Tan yn ddiweddar roedd hi'n amhosib chwilio'n rhwydd drwy gynnwys enfawr y papurau hyn, boed yn lleol neu'n genedlaethol, i ganfod cofnodion penodol – ac roedd rhaid bodloni ar bori ar hap mewn archifdai ledled Cymru a thu hwnt. Ond chwyldrowyd y broses erbyn hyn gyda gwasanaethau ar-lein wedi eu seilio ar sganiau o dudalennau a thrawsgrifiadau digidol awtomatig ohonynt, fel y gwelir ar wefan y Llyfrgell Genedlaethol (1810-1919)[4].

Esgorodd rhai digwyddiadau eithafol, megis storm fawr y *Royal Charter* 1858, neu eira mawr 1947, ar erthyglau, atgofion ac ymchwil academaidd a gyhoeddwyd flynyddoedd a hyd yn oed ddegawdau yn ddiweddarach. Bu achlysuron o'r fath, yn faes poblogaidd i feirdd gwlad yn ogystal, a cheir sawl engraifft o hynny yn 'Llyfrgell' gwefan Llên Natur.

Gwaith eto i'w wneud

Cwestiwn hanfodol yw a fedr data hanesyddol fel sydd yn Y Tywyddiadur roi canlyniadau mesuradwy i ni a fydd o fudd i astudiaethau newid hinsawdd? Eisoes mae gwaith ar droed i galibreiddio'r gwahanol setiau o ddata sydd eisoes ar gael gyda'i gilydd, e.e. i weld a oes cysondeb rhwng cofnodion tywydd o ddyddiaduron William Bulkeley yng ngogledd Môn, yng nghanol y 18fed ganrif, a data eraill o'r un cyfnod megis cofnodion meteorolegol o logiau llongau oddi ar yr arfordir cyfagos, cylchoedd blynyddol mewn coed o adeiladau oedd yn cyfoesi yn yr ardal a'r cylchoedd mewn cregyn môr, e.e. y gocosen ddu (*Arctica islandica*). Bydd y gwahanol setiau data hyn yn gosod meini prawf i'w gilydd ac os yn llwyddiannus bydd y gwaith calibreiddio'n hwb i ddatblygu methodoleg ymchwil i gyfnodau eraill nid yn unig yma yng Nghymru ond mewn ardaloedd eraill lle mae data tebyg ar gael. Defnyddiwyd gwaith gwirfoddol "Gwyddoniaeth y Werin" ar raddfa fawr yn Lloegr i gofnodi logiau llongau i berwyl tebyg.

Cais am ddyddiaduron

Os ydych yn gwybod am ddyddiaduron, hen neu ddiweddar, ac unrhyw ddeunyddiau eraill sydd â chofnodion amgylcheddol dyddiedig a lleoliedig ynddynt, gadewch i ni wybod (www.llennatur.com), a chofiwch ein bod yn chwilio am wirfoddolwyr i fewnbynnu data o'r fath i'r Tywyddiadur.

*Bu **Duncan Brown** yn warden gwarchodfeydd natur gyda Cyngor Cefn Gwlad Cymru a chyn hynny gyda'r Cyngor Gwarchod Natur. Ers ymddeol bu'n canolbwyntio ar ffyrdd o weld y byd naturiol trwy ffynonellau lleol a thrwy bersbectif hanesyddol. Mae'n olygydd Prosiect Llên Natur ar ran Cymdeithas Edward Llwyd.*

*Mae **Twm Elias** yn ddarlithydd a threfnydd cyrsiau ym Mhlas Tan y Bwlch, Canolfan Astudio Parc Cenedlaethol Eryri ac yn weithgar gyda sawl prosiect amgylcheddol/cymunedol; yn cynnwys Cynefin a Chymuned a Llên Natur.*

Cyfeiriadau

1. *Perlau'r Pridd – Dyddiaduron Defi Lango*, Gol.Goronwy Evans (2009)
2. DO Jones, yn achlysurol yn Yr Odyn, papur bro Dyffryn Conwy (1976 – 2014)
3. *The Morris Letters*, H Davies (1907)
4. Papurau Newydd Cymru Arlein (www.llgc.org.uk)

Wales weather

Y Tywyddiadur is an exciting database of historical and contemporary data on the weather and phenology of Wales. It is part of the Llên Natur project which records and celebrates the relationship between people and the natural environment. Records can be found in old diaries, ships' logs, letters and postcards, poetry, newspapers and other publications, and even graffiti! The work is ongoing and is already demonstrating the relevance of this information to wider studies of the environment and climate change. Y Tywyddiadur is a comprehensive multilingual database, and presents all entries in their original language. www.llennatur.com

A full translation of this article is available on request or via our website www.naturcymru.org.uk

All photos: Fred Slater

"The Professionals"

the rise of the modern ecologist

Looking for fairy shrimp, pillwort and rare insects in ephemeral ponds, Radnorshire

From the tweed-clad, eccentric but expert amateur naturalist of a generation ago, it has been a long journey to the modern ecologist. Ever-increasing pressures on our countryside and townscapes, mitigated by legislation and regulation, have created the relatively new profession of ecologist to service this changing world, as ***FRED SLATER*** *explains.*

When I became a "professional" ecologist some 40 years ago, I used my degree to get a job with what is now Cardiff University as Director of its then new Field Centre in mid-Wales. The work involved researching such things as the biological and environmental consequences of enlarging a reservoir in the Elan Valley and initiating bat, bird and amphibian surveys, as well as teaching undergraduates the fundamentals of field biology. On my arrival the local builder (and undertaker!) expressed disbelief that someone could earn, or even justify earning, a living as an ecologist! "An ecologist – what's one of them?" he asked. "I know what farmers, publicans and builders do – but ecologists?"

Forty years on and yes, things have changed. Farmers are paid to be environmentally friendly, planners give brownie points for green design, and even feeding birds – provided they are red kites – can keep the farm tills ringing. Ecologists are now widely recognised and either loved or hated for the roles they play.

Surveying short rotation willow coppice for small mammals

Changing needs for changing times

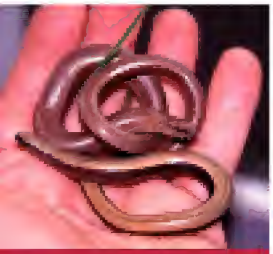
In my early days, outside academia, professional ecologists in Wales were as rare as the red kite (then just a handful in Wales). In general, by far the best naturalists in those days were amateurs, contributing greatly to our knowledge, but they were not usually skilled advocates whose evidence would carry weight in the eyes of bureaucracy. Now, to satisfy the needs of planning and environmental law and regulation, some ecologists have become intermediaries between the real world of nature and the office-bound officials of regulation. Others brave the elements to teach yet others about the ways of the natural world, and still other ecologists push forward ecological frontiers as academics in Wellington boots or waders, white-clad in sterile laboratories, or hovering over a 'mouse' creating simulations of nature in computer time and space. The one truth about ecologists is that there is probably no typical ecologist. Their range of skills and interests are as wide as the natural world itself and as complex as the web of influence which man weaves into this world.

But, because of the need for this diversity of skills, combined with the decline in formally taught identification skills in universities and colleges, it became clear two or three decades ago that an independent yardstick was required by which to measure the professionalism of ecologists and environmental managers, as these would be the people advising government about the impacts of proposed developments on our landscape and wildlife. It might be said that the profession of ecologist and environmental manager gained respectability when the Institute of Ecology & Environmental Management (IEEM) was formed in 1991, and then came of age in 2013 when the Institute gained its Royal Charter and became the Chartered Institute of Ecology & Environmental Management (CIEEM). Members of the Institute can use MCIEEM after their name and the Institute can now offer the ultimate accolade to ecologists at the top of their profession of Chartered Ecologist (CEcol).

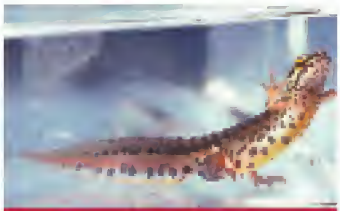
Measuring toads

The job of an ecologist

This still does not fully answer my old builder friend's question of what do ecologists (and environmental managers for that matter) actually do? I will take myself as an example of someone who has spanned ecological consultancy, teaching and academic research, to give a flavour of the variety of ecological work on offer. One of my first tasks, some 30 years ago, was organising a team of leading UK ecologists to help a now influential landscape consultancy found an ecological arm, resulting in a contract for a major infrastructural freshwater project on the edge of the New Forest. Subsequently I have travelled widely in the UK (and abroad), from proposed incinerator sites near Newcastle in the north to development sites on the Jurassic south coast; I have counted great crested newts in Devon in the west and botanised at Sandringham in the east; I've worked on major wind farm sites in both England and Wales and given evidence at numerous public inquiries; and I have advised on peatland protection in the Welsh uplands and assessed the ecology of the eastern section of the M4. Further afield, I have advocated biofiltration for dolphin protection on the River Indus in Pakistan, helped mitigate major developments in Majorca, and helped to evaluate the ecological consequences of biomass willow plantations in New Zealand. I've offered advice on



Slow worms



Occasionally amphibian surveys turn up something exciting (hybrid smooth/palmate newt)

Red-eared terrapins at Cosmeston Lakes, Penarth

sustainable development in Cape Verde and worked on numerous projects in the UK covering, amongst other things, birds, bats, amphibians, otters, native crayfish, biofiltration, bioenergy crops and even a proposed fossil quarry. Multiply my range of experience by the several thousand ecologists working in Britain today and the 'no typical ecologist' epithet becomes clearer.

In academia, studies by professional ecologists might involve pure observation, molecular genetics, chemical studies and/or mathematical models, and in Cardiff University alone I can recall my colleagues studying such things as fungi, springtails, earthworms, slugs, invasive crayfish, robins, pied flycatchers, otters, gorillas, orang-utans, elephants, pandas, vicuna, llamas and alpacas, the ecology of bioenergy crops, and river and pond ecology. Multiply this by over one hundred university schools and departments, plus contributions made by field centres, the RSPB and British Trust for Ornithology and other organisations where such things are studied, and the word 'typical' fades further into the ecological mists.

In the world of ecological and environmental management professionals in consultancy and government, the range of expertise on offer is vast, from those dealing with law and regulation to specialists, often in legally protected plants and animals such as bats, badgers, dormice, water voles, otters, white-clawed native crayfish and great crested newts, or the less obvious but often equally important lichens, mosses and liverworts and protected insects. Some train other ecologists in the skills needed to study. Some deal with particular habitats such as grassland, woodland or peatlands while others specialise in aspects of habitat restoration or sustainability. Still others, for example in the Overseas Territories Group of CIEEM, set their sights much further afield, perhaps on penguins, turtles or land crabs.

Gongs and professional recognition

Each year, CIEEM awards medals and prizes to leading ecologists or environmental managers, and briefly looking through the lists of past winners you get a feel for the world class quality and breadth of ecology and ecologists in Britain. The winners include Sir David Attenborough for increasing public understanding and appreciation of ecology; Brian Moss for contributions to limnology; Charles Gimmingham for work on heathlands; Tony Bradshaw for ecological restoration; and Lord Robert May, a mathematician turned ecologist. In 2013 another winner, David Stubbs, who specialises in ecologically sustainable sports facilities, was in charge of sustainability for the 2012 Olympics and now visits all potential Olympic venues to advise on

Giant willow aphid, Anglesey - all part of biodiversity to the ecologist

sustainability. Away from individuals, groups such as Farming and Wildlife Advisory Groups have been recognised for their work, as have the Freshwater Biological Association for their freshwater invertebrate identification training and Scottish Natural Heritage for their raptor monitoring scheme.

Vox pop

When I was asked to write this article I thought that readers might like to know what currently practising ecologists and environmental managers in and around Wales did on a day to day basis, so I asked a random selection and got the following replies (no names no pack drill!).

"I sit in my office and poke numbers into a computer"
"Busy with bird surveys on proposed windfarm sites"
"I've been round farms collecting dog poo to look for parasites – farmers think I'm strange!"
"Had an exciting summer surveying for upland bees"
"Yet another chicken shed with great crested newts in a pond nearby"
"We've been working on wetland creation in the UK and mangrove swamp restoration in Asia"
"I teach at a Field Study Centre and every day is different"
"Late nights and early mornings counting bats for most of the summer"
"My everyday job is to assess the ecological impacts of proposed developments in the county"
"Just spent a week in a dry suit looking for freshwater pearl mussels"
and finally,
*"I'm too busy writing reports and earning my ***** living to answer your ******* ****** questions"*
– even ecologists cannot please everyone all the time!

From the past to the future

I think I always wanted to be an ecologist even though 60 years ago I didn't know what they were. I admired the great naturalists of that time such as James Fisher, Maxwell Knight and Peter Scott, particularly when they appeared on radio and later television. I always imagined being part of the team on Nature Parliament on the Home Service, answering listeners' natural history questions. By the time I achieved this, the Home Service was Radio Four, and a new generation of natural historians was broadcasting and beginning to be called ecologists. Today the demand for good ecologists exceeds supply and this is where CIEEM comes in to its own, keeping standards and therefore the perception of ecologists as high as possible. The deer-stalker hat, plus-fours and tweed have gone and The Professionals have arrived!

The Chartered Institute of Ecology & Environmental Management (CIEEM) is the leading professional membership body representing and supporting ecologists and environmental managers in the UK, Ireland and abroad. It has six levels of membership viz. Fellow, Full Member, Associate, Graduate, Student, and Affiliate, all requiring different levels/combinations of qualification and experience. It holds a register of Chartered Ecologists (CEcol) and through the Society of the Environment Full Members and Fellows can also become Chartered Environmentalists (CEnv). It publishes guidance on professional and technical matters as well as advice for students, and members can be entered on its Professional Directory. For more information see **www.cieem.net**

Fred Slater *worked for Aberystwyth then Cardiff Universities. A Fellow of CIEEM and Chartered Ecologist, he is retired but still teaching, consulting and working with the Royal Welsh Agricultural Society.*

Yr ecolegydd modern

Mae'r daith wedi bod yn un hir yn wir – o'r naturiaethwr amatur ecsentrig ond gwybodus, yn ei siwt frethyn, genhedlaeth yn ôl, hyd at yr ecolegydd modern. Mae angen amrywiaeth mawr o sgiliau ar ecolegwyr, gan eu bod yn gyfryngwyr rhwng realiti byd natur a rheoliadau amgylcheddol mympwyol. Mae rhai yn gwisgo'u hesgidiau dŵr neu eu siwtiau gwlyb yn y bore tra bo eraill yn gweithio mewn labordai glân neu'n bwydo data ar gyfrifiaduron. Y corff sy'n mesur proffesiynoldeb y bobl hyn yw'r Sefydliad Ecoleg a Rheolaeth Amgylcheddol.

Daniel Ahlund

People and pine martens

Pine martens, with their low reproduction rate and large territories, are ill-suited to coping with persecution and new pressures, such as fast traffic. Yet they are a valuable part of the ecosystem, helping red squirrels by predating on greys, and they stir considerable public interest and support. The population hangs by a thread in Wales, but a new project is investigating how to re-establish them here, as ***DAVID BAVIN*** *reports.*

A European pine marten (*Martes martes*) in Sweden, 2012.

The pine marten, Bele'r Coed, a cat-sized member of the Mustelid family (stoats, weasels, otters, polecats and badgers), has diverged from the typical Mustelid life strategy of reproducing rapidly. In place of short generation times, it has a relatively long life expectancy (up to 15 years in the wild), with a low reproductive rate; a strategy which isn't suited to absorbing additional mortality pressure outside of that experienced naturally. As you will come to read, their underlying biology explains their current status.

The pine marten is typically carnivorous; solitary, largely nocturnal and having a large home range which males defend against other males. There is intrasexual segregation (within sexes) but, where male and female territories overlap, they tolerate each other, and a single male territory often encompasses two or three female territories. Our current understanding is that they colonised Britain in two waves, initially from Scandinavia and then secondly from Iberia, achieving their most widespread distribution when forest cover reached its zenith. This dual

colonisation was reflected until very recently by two genetically identifiable populations, one in Scotland and one across England and Wales.

They are our only arboreal carnivore and, although foraging predominantly on the ground for small mammals, their impressive agility enables them to pursue prey into the canopy, creating a niche for themselves. They can also access berries, insects, nests and honey, all of which are significant elements of their seasonal diet. They choose arboreal cavities for rearing young, which afford them protection from ground predators; the lack of suitable cavities in modern woodlands may be a contributory factor in their decline. When tree cavities are unavailable, they will use brash piles, root bowls, disused burrows, rocky caves and abandoned manmade structures. Their distribution thus tends to reflect forested or rugged rocky areas, and has historically retracted in step with forest clearance.

They were traditionally hunted with hounds up until the 20th century, and poisoned and trapped thereafter, until they were fully protected under the Wildlife and Countryside Act, 1981. Their population by this time had significantly reduced, after a brief respite during the world wars when gamekeepers were called up to fight. Their range had contracted to pockets of remote forest and upland in Wales, northern England and the Scottish Highlands. They have since only recovered in the latter region, and our work in Scotland has revealed a steady recolonisation that now sees the pine marten re-established throughout northern and central Scotland, and moving into the Scottish borders. Our most exciting record is from a location just 14km from the English border, so we expect that, within the next few years, the pine marten population in southern Scotland will expand its range into the north of England and bolster the extant marten population there.

Pine martens in Wales

The status of the pine marten in Wales is a bit of a mystery. The Vincent Wildlife Trust has been collecting and collating evidence of persistence for the last two decades. Evidence in the form of continuous sightings, many of high quality from experienced

Lizzie Croose

Pine martens will make dens under boulders if there are no suitable trees

individuals, suggests that they still exist in Wales but at vanishingly low density. DNA evidence suggests that they are of the genetic type found in Scotland, suggesting that these individuals may be the result of translocations and/or escapes or releases from captivity. Furthermore, studies of museum specimens suggest that the native English and Welsh haplotype (the Welsh and English 'signature') may have become extinct during the mid-20th century. Obtaining unequivocal evidence of the extant marten population is extremely difficult, and is something we have only been able to achieve twice in the last six years (a scat in Cwm Rheidol in 2007, and a carcass near Newtown in 2012).

Martens have large home ranges when in a stable population, marking their territory boundaries with scats. This is the principal way we detect them, by walking transects and collecting scats, which tend to be deposited in obvious places and often on manmade paths and tracks. When martens are at such low density however, their territorial behaviour may cease to function – why expend effort patrolling and marking your boundaries when there is no incentive (selective pressure) to do so? Unfortunately, this makes them very hard to find! This is compounded by the fact that they are entirely nocturnal for eight months of the year, are very shy, and prefer to live in areas with thick cover. Given the uncertain status of martens in Wales, the Vincent Wildlife Trust launched a project, People & Pine Martens in Wales (PPMW) at the end of 2012 to try

and answer some of the outstanding questions. The project is funded by a carrier bag levy operated by The Co-Operative in Wales. This sensible way of generating funds has resulted in a number of worthy conservation projects, of which ours is proud to be the pilot.

Restoring pine martens

The ultimate aim of the Trust's overarching pine marten work is to re-establish a healthy, sustainable breeding population throughout their former range in southern Britain, where appropriate. The aims of our PPMW project feed into and facilitate this objective specifically for Wales. We are continuing to gather evidence to try and understand the mechanisms underpinning the pine marten's failure to recover naturally: improving breeding habitat through the installation of secure den boxes (after it was found they were ejecting owls from nest boxes in Scotland!); modelling suitable habitat to map potential range; trying to ascertain if there is an existing population; and raising awareness about its plight in Wales.

The last objective is arguably the most important. Martens have been rare in Wales for 150 years, and very rare for the last 50. They have dropped out of public and rural consciousness, even within conservation circles, yet they are a charismatic, attractive native with a Welsh name – Bele'r Coed. There are numerous places in Wales named after the pine marten, and many historical accounts of pelt sales and hunts - the species even had the dubious honour of insulating King Henry VI (250 pelts no less). The public attitude is generally sympathetic, as our recent public opinion survey has revealed. The survey was mailed out to rural areas most likely to be directly affected by a recovery, and included farmers, gamekeepers and business owners – the vast majority of people would like to see the pine marten re-established across Wales.

As I touched on previously, detecting pine martens is a major challenge. Aside from organising volunteer scat surveys (on top of my own relentless search), we deploy camera traps in areas with recent sightings or a history of occupancy. The cameras are very effective, and have proven capable of providing evidence of all of our carnivores, small mammals, raptors (including Wales's apex predator, the goshawk) and a constant stream of... sheep. I am confident therefore in saying that given the methods at our disposal, and our efforts so far, the pine marten population in Wales barely exists, and requires intervention in order to recover. Why they have failed to recover, given the increase in suitable habitat in Wales over the last century, is a mystery. From my own field experience, there are a number of areas of suitable size and habitat composition that are connected to adjacent areas of similar suitability.

Furs and Furriery by R. Russ Winkler, 1899

At one time martens were commonplace and hunted for their fur

Lizzie Croose

Ideal pine marten habitat on Mar Lodge estate, Scotland

I do not think habitat is an issue. Genetic depression may have been a factor. Though some species seem to be able to recover from genetic bottlenecks, others, notably the red kite, which is now a conservation success story, require an injection of fresh genes to invigorate the population. Regardless of the cause, any casualties, including animals predated or killed on roads, represent a significant hit on a population of animals that is small and constrained by their own evolutionary history (their inability to breed quickly).

Pine martens help red squirrels

As a native carnivore, pine martens fill a niche within our ecosystems. Research by Dr Emma Sheehy in Ireland shows that martens can potentially control populations of the invasive grey squirrel, reducing damage to trees, and benefiting other native species such as the red squirrel. Where martens are firmly established, such as the Highlands of Scotland, nature enthusiasts pay to see them, bringing tourism and revenue into communities and local business. There are thus ecological *and* economic benefits in having a healthy marten population. Ethically, reinstating a native animal to its former range is the right thing to do. Their rarity is a direct result of historical traditions and persecution and under European law we are obliged to try and restore lost former natives where we can.

The combination of these factors, particularly the formal recognition of the marten/squirrel dynamic, has encouraged us to go public, with the release of our plans to carry out a feasibility study into the potential for future re-establishment. This will be ground-breaking work, the first of its kind. No carnivore population has ever been re-established in these circumstances in Britain and, backed by governmental bodies whose representatives sit on our strategy group, we are proud and excited to be initiating this work.

It is my personal hope that the pine marten will become a symbol of conservation success, and represent an enlightened attitude towards our carnivores. Its association with healthy, robust woodlands and its wildness and mystery, makes the pine marten an ideal figurehead for ecological recovery in Wales.

David Bavin *worked on projects in the Highlands, notably on pine martens and our other carnivores for the RSPB and Stirling University in Abernethy, the Mar estate and the Flow Country, and also as Head Ranger at the Aigas Field Centre, before coming to work for the VWT. Conservation is his passion, and he is particularly interested in restoring balance to our ecosystems through the restoration of missing species.*

Pobl a'r bele

Yn ystod y 20 mlynedd diwethaf mae'r Vincent Wildlife Trust wedi bod yn chwilio am dystiolaeth fod y bele yn dal i fodoli yng Nghymru. Mae'n ymddangos mewn llawer o ddogfennau hanesyddol ac mewn enwau lleoedd, sy'n dangos ei fod, yn wir, yn anifail brodorol. Mae poblogaethau yn cynyddu yn yr Alban, ond yng Nghymru anaml iawn y gwelir yr anifail cigysol sionc hwn. Mae'n gwneud ei wâl mewn ceudod hen goed, a gallai'r prinder o leoedd addas mewn fforestydd modern fod yn ffactor gyfrannol. A ddaeth yr amser i'w ailgyflwyno mewn modd rheoledig?

In pine marten footsteps

gathering the evidence

There is still doubt as to whether viable populations of pine marten exist in Wales, but for every naysayer there's a dedicated individual determined to get to the bottom of it. TOM FAIRFIELD reports on his attempts to record martens in the forests of Wales.

All photos Tom Fairfield

The hind foot of a pine marten, with five digital pads and a four-lobed palmar pad.

Some 20 years have passed since I first encountered a pine marten *Martes martes* in the Welsh Marches, an event recorded in the Pine Marten Survey of England and Wales 1987-1988[1]. Within a few days of the sighting I met with Johnny Birks for the first time. Interest piqued and, encouraged by Johnny, I began my own search for the "wildest of the wild things", the ethereal Welsh marten.

In the continuing search for the pine marten in Wales committed researchers have to use all the methods at their disposal. Artificial dens were deployed, scats hunted, interviews conducted with others who had encountered marten, correlations made, dots put on maps and those who suggested extinction rebuffed! I was to see marten again on a number of occasions within the shadow of the Black Mountains, and experience the frustration felt by others engaged in the hunt for this elusive mammal.

Best foot forward

My field work takes place in large, upland, commercial conifer forests which contain a broadleaf component and open spaces, including temporary clear-fell areas. In 2008 I began to use a new monitoring tool – tunnels and tracking boards, introduced to me by Dr Roger Trout of Forest Research. Mammals are encouraged, with bait, to pass through the tunnels and over an inked mat: their tracks are then recorded as footprints on paper, and the prints compared with others obtained from a hard substrate.

Tunnels and tracking boards

"Tubex" shrub guards 120 x 17cm.

Brown wrapping paper 11 x 48cm.

Spray for papers: 50g tannic acid, 475ml ethanol and 475ml water.

Laminated plywood boards 115 x 12cm with central 15 x 9 x 0.5cm inkwell.

Ink: 250g ferric nitrate, 360g polyethylene glycol & 810ml water.

Elastic bands secure the papers to the tracking board, with one paper either side of the inkwell.

The mammal tunnel, with papers in place and a central inkpad.

The tunnels are placed along linear features likely to be used by the martens. The idea is to place them wherever martens may pass from the relative safety of trees or rocks to the ground areas that are potentially good foraging areas. I have secured tunnels to fallen or deliberately felled trees across watercourses, and placed them on walls, under constructed log piles, and in vegetation along harvesting interfaces. The locations may be 'fine-tuned' over a few months, but once in place the monitoring points remains fixed. The individual tunnel locations are recorded by GPS and given a number, which is then written onto the pairs of corresponding papers when fastened to the board. Occasionally forestry harvesting may cause a monitoring point to be suspended, and in some instances terminated.

Not so alluring

For a three month period I used a marten lure, sprinkled around a small number of tubes. Anyone who has come across this stuff will know it is a thick, dark liquid emitting the most appalling odour, with antisocial implications for the user, especially if spilt in a vehicle. Eventually it seemed prudent to actually observe the reactions of a captive marten exposed to a small amount of lure placed on a piece of rag. It was seen to trigger sexual aggression in a captive male marten. Subsequently I stopped using the lure around the tubes in case it was equally effective as a deterrent to some martens! I still occasionally use it in hair tubes.

Collecting the papers...

Each pair of papers in the individual tunnels is renewed monthly. The collected papers are rolled as pairs and secured with an elastic band. All rolled papers, whether wet or dry to touch, are aired on a radiator or windowsill as soon as I get home. Once fully dry they are stapled in their pairs and laid flat under a block of wood for a few hours to straighten out.

... whatever the weather

Using paper outside in all weathers is not without its problems. During periods of very wet weather it can become saturated and care is needed to retrieve the samples successfully. In prolonged hot weather some of the inkwells dry out between the monthly visits but it is important not to over-wet the inkwell matting when replenishing it, as the ink can spread beyond the well and spoil the papers. In very cold weather I have dug for tunnels under snow and then removed the frozen paper from the boards whilst warming them under the truck cab heater. Wind can detach the papers from the boards, and also poses a challenge during collection and replacement. Small mammals will occasionally gnaw the elastic bands and the boards, and even eat the inkwell matting: there is always a spare board or two carried in the truck. Time, however, has shown only approximately 5% of the papers have been spoilt by such factors over a five year period.

I was initially concerned about potential print distortion in wet conditions. I experimented with some of the collected papers, first measuring the dry mammal prints, then saturating them under running water. I was pleasantly surprised after drying the papers and re-measuring them that there was no discernable distortion. Occasionally some prints

feather slightly at the edges when obtained after periods of prolonged rain. This is probably due to the mammal feet, inkwell and papers being saturated.

Examining the evidence

The pine marten foot has five toes with digital pads and a four-lobed palmar pad. On the forefeet there is also a small proximal pad. The width of the foreprint on a firm substrate will vary from 35-55mm with a length of 40-55mm. The hind foot ranges from 40-55mm wide and 45-65mm long. Hair may also show on the prints, especially during winter pelage, and the semi-retractile claws can show on 'pulled' papers.

For identification I referred initially to a short guide for identifying footprints on tracking papers[2], along with some copies of marten prints obtained from tracking papers in Scotland via Forest Research. To remove any doubt, captive marten and polecat of a known weight, age and sex were persuaded to pass through tunnels placed in their enclosures, so providing verified reference prints.

Gait can also help to identify the prints. Polecats usually 'bumble' through the tunnel, leaving several prints, whereas it is suggested the wary marten may bound through and try to avoid the inkwell. A single strike, conforming to that of marten, on the last few centimetres of a paper furthest from the inkwell will be given a higher confidence rating. On one occasion a marten appears to have passed through a tunnel and deliberately pulled at the papers. A female captive marten was also observed to do likewise.

Many years experience of examining papers does now mean prints conforming to those of marten catch my eye as soon as I draw the board out of the tunnel. In practice it is only around 1 in a 1000 sets of papers that yield something interesting. Very few high confidence marten prints have been obtained.

The papers also record the passage of smaller mammals, giving some indication of the potential foraging resource for marten. One vole, however, can be responsible for many footprints on a paper.

Careful measurement and comparison of marten prints will distinguish them with a high level of confidence from other members of the tribe. Passive monitoring with tracking tunnels can confirm the animal's presence when other hard evidence is difficult to obtain. The marten remains an enigmatic and elusive mammal, surviving at low densities in Wales and the Marches.

This print shows five digital pads far forward of the palmar pad and traces of the proximal pad

Acknowledgements

I am grateful to Rob Strachan, Steve Cresswell, Dr Roger Trout, Iolo Lloyd, Nick Smith, Emyr Ellis, Ed Clark, Dara Mullins, Arthur Wiggins, Johnny Birks and Carol Heap.

***Tom Fairfield** has provided national training for public and private sector land managers relating to dormice, otters and other endangered species. He actively undertakes or contributes to woodland management operations and undertakes a small amount of consultancy work.*

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Olion traed belaod y coed

Mae yna eto amau a oes poblogaethau hyfyw o felaod y coed yng Nghymru. Cipolwg yn unig a geir ar fela byw, fel arfer, a gellir camgymryd ffwlbart am fela. Un modd eu holrhain yw eu twyllo i adael eu holion traed ar bapur mewn twneli mamaliaid a gynlluniwyd yn arbennig, ac a osodir ym mannau yng nghynefin addas ar gyfer belaod. Trwy gymharu'r canlyniadau ag olion traed belaod a ffwlbartiaid caeth, gobeithir canfod tystiolaeth bendant i'w presenoldeb.

Bryophytes in the Woodland Trust's ancient woodland

It's a sunny day in late September and local bryophyte expert Brian Burnett is running a bryophyte walk at the Woodland Trust's Plas Power Woods near Wrexham. We don't have to travel far to find our first specimen: silver-moss, *Bryum argenteum*, growing on a drystone wall metres from the Nant Mill Visitor centre.

Mosses, liverworts and hornworts are all termed 'bryophytes'. They are non-vascular plants (i.e. they do not transport water around the plant in vessels containing lignin) and they do not have seeds or flowers. Instead they reproduce via spores. Often small and easily overlooked, they are nonetheless an important part of many ecosystems, as the plants around them benefit from the water and nutrients they collect.

Most mosses and liverworts thrive in moist conditions so, as we venture deeper into the woods that run alongside the River Clywedog, more species are found. Brian patiently explains the difference between a moss and a liverwort. Mosses can further be divided into acrocarps, sometimes called hairy mosses, which grow upright and bear their spores at the tops of their stems; and pleurocarps, which grow in wefts or mats that spread horizontally. They have spores growing from the sides of main stems. Liverworts can also be split into two groups: the leafy liverworts that have a stem and leaves; and the thallose liverworts which have no distinct stem and leaves.

The study of bryophytes is aided by a hand lens and a water spray bottle on this dry day, as well as an expert guide to help us get started. Brian explains that most bryophytes are visible in all seasons, offering round-the-year interest to the botanist, and are often more visible when the flowering plants recede in winter.

Moving across Wales to the wetter Atlantic climates of western Wales, our Atlantic bryophyte flora is outstanding and among the richest in the world. The Woodland Trust is lucky enough to manage a number of Atlantic Oakwoods in Meirionnydd which have considerable bryophyte interest. The deep, humid gorge of the Afon Prysor in Coed Felinrhyd is among those special places, designated as a SSSI and Special Area of Conservation. As the waters of the Afon Prysor tumble through Ceunant Llennyrch, its spray lingers in the air, creating a warm and misty microclimate. Mosses and liverworts carpet the ground in this temperate rainforest, and include many uncommon species: the nationally rare moss *Sematophyllum demissum* occurs on boulders within the gorge, alongside a further 25 nationally scarce species, many of which occur nowhere else outside western Britain. Rare ferns also inhabit this damp other-world; species such as the Tunbridge filmy fern.

The woodland floor is also rich in mosses: in nearby Coed Cymerau Isaf, the observant visitor may spot *Ptilium crista-castrensis*, sometimes known as Knight's Plume Moss.

Such habitats are fragile, however, and may be susceptible to damage from heavy recreation pressure, invasive species, hydro-electric power schemes, or sudden changes in humidity brought about by intensive forest operations that rapidly open up the canopy. These little-known and unobtrusive species may occupy a tiny niche that can easily be destroyed by unsympathetic management or even a carelessly placed boot. Where special sites have been damaged in the past by the influx of species such as rhododendron and the plantation of ranks of exotic conifers, the Woodland Trust has been working long-term with partners in Natural Resources Wales to gradually restore the semi-natural broadleaved woodland on which these fascinating plants depend. Hopefully future generations will be able to continue to enjoy these unusual environments and rich biodiversity that they support.

***Rebecca Good** and **Kylie Jones Mattock** manage the Woodland Trust's woods in North Wales.*

For more information see:

North Wales Non-flowering plant group: http://nwnfpg.blogspot.co.uk/#!/p/links.html

British Bryological Society: http://www.britishbryologicalsociety.org.uk/

Woodland Trust Woods: http://www.woodlandtrust.org.uk/visiting-woods/

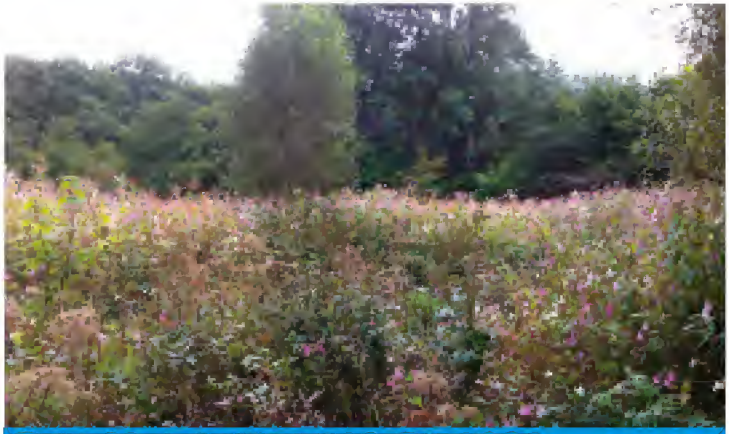
Habitat Management

Pistyll Gwyn in Carmarthenshire is 20 acres of dry and damp grassland, wet woodland, ponds, and river frontage. The owner, knowing that the site is valuable for wildlife, has managed it sensitively with light pony grazing. However, over time pony grazing has not been sufficient to stop some areas developing into scrub – in itself a valuable habitat, providing a food source and shelter.

The grassland varies from dry neutral pasture with self-heal, ribwort plantain, greater bird's-foot trefoil, black medick, bugle, yellow rattle, common cat's-ear, autumn hawkbit, sweet vernal grass and crested dogs tail, to damp 'rhos' pasture with purple moor-grass, rushes, mosses, sedges, devil's-bit scabious, tormentil and common spotted orchids.

After many years of low intervention the areas of scrub at Pistyll Gwyn had increased in size, areas of bracken were spreading across the grassland, a wave of bramble was following the bracken encroachment and the ponies were concentrating their grazing pressure on the ever-reducing area of species-rich grassland. These were not the only problems. Himalayan balsam, seeding itself upstream, had germinated along the river banks and within scrubby areas. Despite hours of hand pulling, some plants were inaccessible within the bramble and blackthorn scrub and, as each surviving plant can produce 800 seeds, however much was pulled there were always hundreds more plants the following year. Around six acres of land soon became an impenetrable block of advancing bramble, bracken, tree saplings, gorse and, during the summer months, Himalayan balsam.

All photos: Conservationandtrees.co.uk



Himalayan balsam and scrub in summer before the work started

As contractors, our family business was engaged to draw up an achievable annual management plan to halt the loss of species-rich grassland. Working with the landowner, we successfully applied for grant funding to contribute to the cost of the work. Pistyll Gwyn received funding from Sir Gar's Landscape and Heritage Grant for their species-rich grassland project. This grant, delivered by Carmarthenshire County Council's Tywi Centre, aims to support projects that promote the area's cultural distinctiveness. It is funded by the Rural Development Plan for Wales 2007-2013.

We began work during the winter of 2013. At first we concentrated on clearing scrub with the aim of reclaiming grassland, and so that we could get access during spring and summer to as much of the land dominated by Himalayan balsam as possible. This was done using a low impact tractor with a topper to chop up the bramble, and a chainsaw to remove the bigger young and fallen trees, so that we did not damage the sward on this sensitive damp grassland site.

There was no record or evidence of dormice on the site, but due to the nature of the scrub and proximity to other known sites, we took great care when carrying out the scrub control. In an area where Himalayan balsam is not a problem we retained a 3m deep boundary of bramble and blackthorn scrub close to a recently planted hazel hedge. This, we hoped, would provide a potential habitat to encourage dormice in the future.

By spring 2013 we were able to cut vast areas of the Himalayan balsam effectively by low impact tractor with attached heavy duty topper prior to it flowering. The topper cuts low which prevents regrowth from the cut balsam stems. The machine also chops up the cut material so that it doesn't take too long to break down. We hand-pulled, scythed, and strimmed remaining plants. We also cut the bracken in July / August when it is most

vulnerable, and carried out an annual autumn cut of encroaching bramble. The latter is to further control the bramble, but also to ensure there is less bramble growth by the spring cut of Himalayan balsam, making the job much more manageable.

On sensitive sites management has to be flexible. Each season's growth and ground conditions differ, and we need to regularly monitor the effect of our management, and then adjust the plan accordingly. Having the correct equipment and knowing how to use it effectively is vital. Above all, we need to prevent damage to existing habitat, so that management sometimes comes down to manual labour and hard work!

As a result, an increase in open areas and accessibility is very obvious. After the first year's work we are looking forward to the new spring growth with anticipation. We, and the owner, will need to be patient as the reclaimed grassland will require time to recover before providing grazing for the ponies. Over time, reduced pressure on the existing grassland should allow it flourish.

In a few years, the time spent annually on practical management will reduce to a minimal maintenance level. Due to the amount of Himalayan balsam that is growing upstream, and the bramble along the field boundaries, the problems will never go away, but with correct and regular management they will be controllable.

It is a pleasure to be involved in such a rewarding project.

Ivy Denham *www.conservationandtrees.co.uk*

Mulching Himalayan balsam with compact tractor

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New species of fossil crinoid discovered in south Wales

South Pembrokeshire has long been regarded as a classic area for the study of Upper Palaeozoic rocks. West Angle Bay at the extreme western tip is renowned for both its complex tectonic structures and its well-exposed coastal section, from the part-terrestrial Lower Devonian into the fully marine lower section of the Carboniferous Limestone.

In the Lower Carboniferous (about 350 million years ago), Wales was situated close to the equator and covered with shallow tropical seas. The climate was typically tropical with frequent intense storms which usually smashed the shells of most marine organisms into small pieces before they were fossilised. However, a few layers contain whole fossils, and these were deposited in deeper water, below the levels churned up by storm waves. The rocks of West Angle Bay have been logged in intricate detail, revealing an overall deepening upwards sequence presumed to be linked to a global transgression, or sea-level rise, following a minor glaciation phase.

During recent fieldwork at West Angle Bay I discovered an interesting new crinoid fossil; a small marine animal that looked a little like a plant. Crinoids have a long flexible stem anchored into the sea-bed, topped with a small calyx, or cup-shaped structure, containing the internal organs. Long, flexible, feathery tentacles are extended up above the animal and these filter micro-organisms from the seawater, channelling them down to its stomach. In life this new crinoid would have probably been around 30-40cm in height.

Amgueddfa Cymru – National Museum Wales

Hylodecrinus cymrus – the holotype, and only specimen

The fossil was very carefully extracted from the rocks, and then prepared further in the laboratory to reveal more detail. In collaboration with Professor Tom Kammer from West Virginia University, an expert on Carboniferous crinoids, it was determined that this was a new species and, furthermore, from a genus never before seen outside the USA. It has been given the name *Hylodecrinus cymrus* to illustrate its Welsh origins. So far this is the only specimen of the new species, which is characterised by its highly ornamented plates. Eight other species of this genus have been found in the USA, one of which (*H. carinatus*) is similar enough to be presumed closely related. This supports the hypothesis of a migration route from North America to Europe during the early Carboniferous. The description of this new fossil was published online early in 2013, in the Geological Journal.

Amgueddfa Cymru – National Museum Wales

Reconstruction of *Hylodecrinus cymrus*

***Cindy Howells** is a palaeontological curator at Amgueddfa Cymru – National Museum Wales.*

Wild daffodils

The National Flower the daffodil has a poisonous bulb and shares the compound galantamine with the snowdrop. Recent research has shown that this compound is useful in the treatment of Alzheimer's disease: there is on-going research being done in Wales. However there are numerous cases of poisoning from the consumption of daffodil bulbs, mistaken for onions! The symptoms are vomiting and diarrhoea and can last for two or three days.

The genus *Narcissus* consists of 30 or more species, most of which occur in Spain and the Mediterranean. From these species nurserymen have raised thousands of cultivated varieties, of varied size and form, ranging in colour from white through a whole range of yellows, to orange and even apricot and salmon pink. The flowers can be single, double, small, or so large the stems of the plant bend under the weight of the blooms.

The wild daffodil *Narcissus pseudonarcissus*, (cenhinen bedr in Welsh) was common throughout England and a good portion of Wales in the 16th century and remained widespread until the 19th century when it slipped into a rapid and mysterious decline. It now has a restricted distribution, mainly centred in South Devon, the Lake District, Gloucestershire, Herefordshire and the Welsh borders (see *Natur Cymru* 34). The Tenby daffodil is recognised as a sub species *Narcissus pseudonarcissus ssp. obvallaris,* common in fields between Tenby and the Preseli Mountains.

The Welsh botanist R. A. Salisbury first recorded the Tenby daffodil in 1796 and gradually it became a highly prized and much sought after bulb, and was systematically dug up to be sold in London. An ambitious nurseryman called Mr Shaw became the most ruthless plunderer of the bulb: indeed, the local farmers, who regarded the daffodil as little more than a weed, were quite ready to sell them for a trifle. As a result the naturalist Charles Tanfield Vachell delivered a paper to the Cardiff Naturalists' Society in 1894 complaining that the popularising of the 'Tenby Daffodil' was leading to its virtual extinction in the wild.

Today the reverse is true and although wild occurring specimens are much reduced, the mass ornamental plantings of the Tenby daffodil along with other varieties have actually led to fierce criticism. The saturation of country towns with daffodils was first discussed by the Welsh Office in 1992 when Abergavenny Council was attacked for becoming over-narcissistic and it was suggested that there were too many daffodils in Wales.

Some botanists consider that there are no wild daffodils native to these parts and think that they have been introduced to our fields and woodlands by earlier visitors to our shores migrating from southern Europe. Whatever the case daffodils are very much part of the spring countryside, be they "wild" or cultivated, and in Carmarthenshire there is one daffodil that is very special. The Derwydd Daffodil was first discovered at and named after a garden in Llandybie: it is most probably a double form of the Tenby Daffodil. Strange rather than beautiful with its double flower being more green than yellow, it remains a botanical curiosity.

Simon Goodenough *is Curator at the National Botanic Garden of Wales.*

Rod Gritten

Tribute to Morgan Parry

Cyfoeth Naturiol Cymru

Morgan Parry was a great supporter of this magazine, attending the earliest discussions aimed at getting Natur Cymru (a title he argued for) off the ground, lending WWF Cymru's financial and moral backing as its Director, and writing an insightful article about Welsh agricultural policy post Foot and Mouth Disease in its first (now collectable) edition. He also argued strongly that we should cover broad environmental issues like sustainability, rather than retreating into a 'wildlife ghetto'.

Morgan Parry has left his mark on this magazine, as he did on so many of the causes and organisations he supported, and on the people he worked with. His contribution is recorded elsewhere, (eg see *Guardian* obituary 15 January 2014). Morgan's abilities were unique, as the following two appreciations show, but he will remain a source of inspiration and of determination that we should do better for nature, and give the term sustainability real meaning.

In 2007 I became Minister for Environment, Sustainability and Housing. One of the first people across my doorstep was Morgan, then Director of WWF in Wales, delighted by my new responsibilities and determined to help me make the most of the opportunity. That was my first meeting with him; the first of many.

Morgan was continually seeking collaborative solutions to environmental threats. The establishment of the Welsh Climate Change Commission was influenced by Morgan, as was the narrative around 'One Wales One Planet', the 2009 initiative to put sustainable development at the heart of government decision making. In 2010 he became the Chair of the Countryside Council for Wales, where he supported merging the Countryside Council for Wales, the Environment Agency and the Forestry Commission into Natural Resources Wales to strengthen its voice.

Morgan's influence was profound because he lived his values. He worried about his and Wales's carbon footprint, acted accordingly, and challenged the rest of us to do the same. He was a Cymro to the core. If my own Welsh is better discussing the environment than it is for social actions, that is down to Morgan; ever patient, ever helpful, and ever determined that he should be able to use his first language to express his views.

Morgan may have been cruelly wrenched from his family before his time, but his influence lives on in us all. It is now our job to make sure that we create a legacy from his passing to inspire future generations to care as he did.

Jane Davidson

Dewisodd ei frwydrau a'u hymladd i'r pen

Pan glywish i gynta rai blynyddoedd yn ōl bod yna rhyw "Morgan Parry" wedi cael ei benodi yn Gadeirydd Y Cyngor Cefn Gwlad, doedd yr enw ddim yn taro i ddechrau. Morgan pwy? meddwn i. Mi gymerodd hi bythefnos i'r 'geiniog ddisgyn': 'O, Morgan *ni*?' Dydy 'hogia ni', hogia'r maes ddim i fod i gael eu dyrchafu i'r entrychion fel 'na!

Fel rheolwr Parc Glynllifon ddois i i'w adnabod gynta, wrth weithio ar gynllun rheolaeth yn yr '80au. 'Roedd y Morgan hwnnw yn daer yn erbyn hela llwynogod, ac fel y dywedodd ar y pryd, yn ei ffordd ddiflewyn ar dafod, "fydd yna 'run helfa llwynogod ym Mharc Glynllifon tra bydda'i yma!".

Ychydig a wyddwn ar y pryd beth oedd ei gynlluniau go iawn. Cefais syniad amdanynt er hynny pan

Teyrnged i Morgan Parry

soniodd am ei swydd yng Nglynllifon fel prosiect 'dechrau a gorffen'. O gofio hynny, ni ddylasai gweddill ei yrfa fod yn annisgwyl i mi.

Cyfarwyddwr Ymddiriedolaeth Bywyd Gwyllt Gogledd Cymru (cymreigiodd y sefydliad hwnnw yn llwyr), sefydlydd Swyddfa Cymru o Gronfa Bywyd Gwyllt y Byd (nid oedd honno yn bod cynt), Cadeirydd y Cyngor Cefn Gwlad - mae ffrwyth ei waith yn y fan honno yn dal i aeddfedu ar ffurf y corff newydd, Cyfoeth Naturiol Cymru. Gyda sêl a chydweithrediad staff y tri hen gorff, y Comisiwn Coedwigaeth, y Cyngor Cefn Gwlad ac Asiantaeth yr Amgylchedd - ar bob lefel, hyderwn y caiff gweledigaeth Morgan ei gwireddu y tro hwn hefyd. O dan y corff newydd hwn mae gofal am yr amgylchedd a'i fywyd gwyllt yn dyfod i oed.

O'r glaslanc bochgoch yn tarannu yn erbyn hela llwynogod i'r gwleidydd craff oedd â'r gallu i ddewis ei frwydrau a'u hymladd i'r pen, roedd Morgan yn fentor cudd i mi. Pan gefnogais brosiect i greu storfa bwmp ar fynydd Cefn Du, Waunfawr, at Morgan y trois am gadarnhad o'm safbwynt yn wyneb gwrthwynebiad lleol. Yng ngwyneb anwybodaeth a difrawder affwysol y cyhoedd tuag at y broses o Newid Hinsawdd, at Morgan roeddwn i'n troi pan yn digalonni. O flaen y rhai sydd yn taeru mai Saesneg yw iaith gwyddoniaeth, gan Morgan y cefais ysbrydoliaeth.

Pan siaredais i ag o ar y ffôn dri diwrnod cyn ei farw, i gadarnhau trefniant blaenorol i gadw oed yn y flwyddyn newydd ar hyd ochrau'r Fenai, dyma ohirio'r achlysur tan y Pasg... 'os fyw ac iach'. Morgan y tro hwn oedd angen sicrwydd gennym ni. Yn ei wendid gofynnodd am gadarnhad bod ei waith o gadeirio ein Cynhadledd Ban-Geltaidd "Dehongli Cynefin - Datblygu Cymuned" ym mis Tachwedd wedi plesio. Afraid dweud bod Morgan fel arfer wedi rhagori.

Felly pwy ddaw i'r fei yn ei le? Mi ddaw rhywun yn sicr. Pe na bai olynwyr ar y gorwel, byddai Morgan wedi gadael job ar ei hanner. A doedd y gair 'hanner' ddim yng ngeirfa Morgan. Fe'i cofiwn, fel y dymunai gael ei gofio, yn edrych ymlaen i'n dyfodol bregus gyda hyder.

Duncan Brown *- Ymddangosodd fersiwn hwy o'r deyrnged hon yn* Y Cymro, *Ionawr 2014*

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Islands round-up

Richard Brown/ Giselle Eagle

Common dolphin

South and west Wales

Flat Holm: since we last reported on Flat Holm in *Natur Cymru* 35 (2010), Cardiff Council ear-marked the island for sale to save £150,000 a year. A decision was subsequently taken in November 2013 to maintain the nature reserve until April 2015, after which operational control would be transferred to two (un-named) national organisations. The island is an SSSI and a Special Protection Area because of the maritime grassland and rare plants including rock sea-lavender and wild leek.

Ramsey: one of this winter's storms hit Ramsey's mainland base at St Justinians on January 3rd 2014.The doors on the lifeboat station were wrecked and the doors and roof smashed off Ramsey's storage shed, located beside the lifeboat station. Dramatic pictures of the waves and storm damage were posted on the Ramsey Island blog on January 6th, by RSPB warden Lisa Morgan. Lisa and Greg were still on the mainland waiting to get back to Ramsey, but managed to cross a few days later.

There were several highs and lows on Ramsey during 2013. One pair of lapwings probably represented the entire Pembrokeshire population, while the wheatear population remained very high at 107 pairs. Rare migrants in September included a (Western) Bonelli's Warbler and a Booted Warbler. Ramsey has the largest grey seal colony in southern Britain, and between 500-700 pups were born on the island's beaches this year.

Skokholm: The new wardens Richard Brown and Giselle Eagle had a very busy year, rounded off with the news that the Bird Observatories Council had restored official B.O. status to the island. This is particularly noteworthy as the island was home to Britain's first Bird Observatory, established in 1933 by R.M. Lockley. Although ringing ceased in 1976, the daily bird census continued so there is a phenomenal record of breeding and migrating birds back to 1933, the only break being during the war years. These records now all need to be digitised, to allow analysis and comparison with other island data-sets.

Counts and observations continued on the seabirds; a thermal imaging camera showed that many more storm petrels were present than could be spotted by torch-light. A short-eared owl visiting from Skomer was seen to be catching storm petrels. Numbers of razorbills and guillemots are increasing, while the numbers of lesser black-backed and herring gulls have declined considerably in the last 30-40 years. A detailed report on the island's seabirds is available on the website of the Wildlife Trust of South and West Wales.

Pods of common dolphins were seen regularly from the island, and a trip in a visiting RIB allowed the wardens to take some stunning photographs of these handsome cetaceans.

Staying on Skokholm: there are boats twice a week (weather permitting) from 11th April to September, with stays of a week (only) in the puffin season but shorter visits also available in April and from July 11th. Full details on visiting (and volunteering) on Skokholm and Skomer can be found the Wildlife Trust's website.

Skomer: The new team of Eddie Stubbings and Bee Bueche also had a busy first year. Long-term studies of auks by Oxford and Sheffield Universities continued on the island. Six guillemots carrying geolocators were caught so the data could be downloaded. This will then show where the birds have been since the 2012 breeding season.

The number of Canada goose nests found increased from 18 in 2012 to 28. This is rather worrying as they trample vegetation, add nutrients to the soil and out-compete other wildfowl species. Only two nests hatched successfully and it was thought that no goslings actually fledged. This will not stop Canada geese from keeping on trying! More welcome breeders included four pairs of short-eared owls which reared at least four chicks. About four pairs of ravens bred, with numbers increasing to around 100 in September. The vast majority of these had crossed from the mainland, attracted by the large numbers of young Manx shearwaters attempting to get out to sea from their burrows. Some get stuck in hollows or are on the surface during the day, becoming easy prey for ravens and large gulls.

*Collated by **Geoff Gibbs** from RSPB and WTSWW blogs and websites.*

After the storm

During the coastal flood events of December 2013 to February 2014, Natural Resources Wales (NRW) staff were in the front line helping to keep the people of Wales safe from flooding. The peak sea level experienced in December 2013 was the highest recorded in Liverpool Bay during the 21 years since the tidal gauge was established, and the peak levels on January 3rd 2014 were the highest on the south and west coast of Wales for at least 16 years. The impacts on the coastline and defences have been compounded by the successive and sustained nature of the storm conditions and powerful waves over a number of tides and days.

At the same time as working to help affected communities, we have begun to assess the wider environmental implications of the storms. In particular we decided to carry out a simple audit of the impact on wildlife and Wales's nature conservation sites, and to compare our findings with reports from England.

It quickly became evident that a wide range of coastal habitats were impacted by the storms, especially beaches, sand dunes, vegetated shingle and to a lesser extent saltmarsh and soft cliff. In a conservation context they included habitats of principal importance for conservation in Wales (under the Natural Environment and Rural Communities Act 2006). Huge amounts of sand were removed or moved around on our beaches, shingle ridges were driven inshore, and dunes, saltmarsh and cliff were eroded. However, our findings suggest that coastal grazing marsh in Wales was not seriously inundated, with only three reports submitted. This contrasts with the experience in England where extensive areas were submerged in the tidal surge event of 5th and 6th December 2013.

Nationally and internationally important conservation sites and their features have been affected. Records to date have identified change at 37 Sites of Special Scientific Interest and 10 Special Areas of Conservation.

A quarter of Wales's nationally important geodiversity sites include sections of coast. Features include active processes, static landforms and stratigraphical or fossil interest exposed in coastal cliffs. The recent storms have led to large scale changes to the morphology of the coastline in some areas, and have also cleaned or 'freshened' many of the coastal cliffs through the removal of debris and vegetation. These fresh exposures, and new archaeological discoveries such as ancient submerged forest and peat cuttings, will require longer term scientific recording and monitoring.

Fortunately important coastal freshwater habitats (such as Bosherston Lakes, Pembs.) were not impacted by saltwater intrusions which could alter their ecosystems. In contrast, natural coastal lagoon environments have evolved to cope with increases in salinity. The damage to the infrastructure of the Wales Coast Path highlights the challenge of maintaining the route in dynamic environments.

The true extent of the wildlife impact will become apparent when surveys are carried out later in the year. Dormant animals may have been drowned in their hibernation sites, while amphibians could be extremely vulnerable to physiological shock from seawater. In particular, NRW staff have concerns about some rare coastal invertebrate species.

Our exposed coastal areas tend to accumulate relatively large amounts of marine litter, due to topography, and prevailing winds and currents. The storm and nature have done us a favour by collecting this material on to the land but the challenge will be to find a way to remove it from the marine ecosystem.

It is predicted that extreme weather events will become more frequent in future. We need to appreciate the degree of change which can occur during these events, both for people and their environment. In particular, the significant morphological change highlights the importance of ongoing coastal monitoring to inform management of not just built assets but also our natural biodiversity and geodiversity resources.

We are very grateful to all the NRW staff and our partner organisations who contributed to this environmental audit.

Catherine Duigan, Nicola Rimington, Paul Brazier *and* ***Raymond Roberts,*** *Natural Resources Wales.*

You can see photos of the effects of the storms on the Natur Cymru *blog for 14th March 2014 http://naturcymru.blogspot.co.uk/*

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